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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Indexes for the previous 6 months will be found in the First number of July and the First number of January.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

[OFFICIAL NOTICE.]

Eighteenth Annual Meeting, Michigan Gas Association.

OFFICE OF THE SECRETARY,
GAS OFFICE BUILDING,
DETROIT, MICH., August 11, 1909.

To the Members of the Michigan Gas Association: All arrangements have been completed for the 18th Annual Meeting of the Michigan Gas Association, to be held aboard one of the large D. & C. boats, leaving Detroit, September 14th, at 9 A.M. The boat will comfortably accommodate 250. All reservations for staterooms must be made promptly in order to secure accommodations. The tickets, including the berth, all meals, in fact, all expenses from the time the boat leaves Detroit until its return, are $22 each; $3 extra if a stateroom is to be reserved for one person.

This ticket includes the annual dinner and all entertainment features. The following programme has been arranged:

"How We Sold Our Surplus Coke," by Mr. Glenn R. Chamberlain, Secretary, Grand Rapids (Mich.) Gas Light Company.

"Study of Firebrick," by Mr. V. F. Dewey, Engineer, Detroit City (Mich.) Gas Company.

An informal talk by Mr. H. M. Wilson, Chief Engineer of the Technologic Branch, U. S. Geological Survey, Washington, D. C., whose "talk" will be on the "Purchase of Coal."

"Retort Benches," by Mr. A. S. B. Little, Engineer, St. Louis, Mo.

"Illuminating Engineering Problems with Gas," by Mr. Norman Macbeth, Manager of Illuminating Engineering Laboratories, Welsbach Company, Gloucester, N. J.

The sessions have been so arranged that it will give you ample opportunity to see the beautiful scenery of the St. Clair river, the beautiful scenery of the St. Mary's river, and 3 or 4 hours will be reserved at the Soo for inspection of the locks. There will be 3 or 4 hours on Mackinac Island.

Staterooms may be reserved any time prior to September 1st by the deposit of $10.

Any reservations not made prior to September 1st must be made on board the boat the morning of the 14th of September.

Circular, giving full information, may be had by applying to A. P. Ewing, Secretary, Gas Office Building, Detroit, Mich.

Very truly yours, ALONZO P. EWING,
Secretary and Treasurer.

[NOTICE.]

Experience Division, Pacific Coast Gas Association.

PACIFIC COAST GAS ASSOCIATION,
OFFICE, EDITOR OF EXPERIENCE DIVISION,
LOS ANGELES, CAL., August, 1909.

To the Members, Pacific Coast Gas Association:

"Gas Bag:" "Why is the Experience Department Like a Divorce Scandal?"
"Leaky Pipe:" "Give It Up."
"Gas Bag:" "The Experience Department relates to painful Experiences, but a divorce scandal is a painful experience to relatives."

LIBRARY OF CONGRESS AUG 23 1909 COPY DEPOSITED

Be that as it may, what the Experience Department hath brought together let no man tear asunder. Every year we have our sanctified, purified and illuminating union; and it is a union of affinities. Two hearts may beat as one; but no man can beat experience as a teacher. What, then, can so efficaciously teach the gas man as this wedding of Experiences, chaperoned, purified and solemnized by the Editor of the Experience Department? Preparations for the ceremony are now underway, and we need your assistance. Send in your experiences. Speed them along. Brook no delay. Almost any old thing is eligible, and no family names are betrayed. Fall in line: The wedding march is sounding. Fraternally yours, R. P. VALENTINE, Editor.

[NOTICE.]

Wrinkle Department, American Gas Institute.

WRINKLE DEPARTMENT, AMERICAN GAS INSTITUTE,
OFFICE OF EDITOR, GAS OFFICE BUILDING,
DETROIT MICH, March 12th, 1909.

To the Members, American Gas Institute: All members of the American Gas Institute are earnestly requested to forward contributions for the Wrinkle Department as soon as possible.

Your co-operation determines the success of the Department.

F. L. CROSS, Editor.

BRIEFLY TOLD.

THIRD ANNUAL CONVENTION, ILLUMINATING ENGINEERING SOCIETY.—The official programme for the third annual convention of the Illuminating Engineering Society is out, and it surely shows that the Society is progressing, and rapidly. The sessions have been set for the afternoon and evening of the 27th September, the morning and evening of the 28th and the morning, afternoon and evening of the 29th. Of course, the headquarters and sessions rooms are fixed for the United Engineering Societies' Building, 25 West 39th street; and it is also on the course that the exhibition feature of the convention will this year be even more extended and elaborated than the handsome one of a year ago. The exhibition will be held in the premises, No. 5 West 39th street, which is so near headquarters that the show cannot in any sense fail because of the distance that is between sessions rooms and showrooms. The paper list is an extended one, the titles thereon up to the time of writing calling for no less a number than 13, several of which are to be the production of men whose names to the gas fraternity are like unto themselves. The 3 papers are to be supplemented by reports from these Committees: "Nomenclature and Standards," Dr. A. C. Humphreys, Chairman; and "Division of Membership," by Mr. E. L. Elliot. In the paper list the subject of photometry comes in for goodly mention. And in the listing is promised a description of the "Photometric Laboratory of the United Gas Improvement Company," by Mr. C. O. Bond, of Philadelphia. It should not be forgotten by the gas fraternity that that sterling gas man, Mr. W. H. Gartley, of Philadelphia, is President of the Society this term, so it behooves us to assist in any and all degree to the carrying on of a meeting that will be long remembered and distinctive in the Society's annals. It, of course, goes without declaiming it loudly, that the social features of the convention shall be of an order that will cause those to be in every best sense enjoyable. That part of the programme is necessarily not complete now, but it is surely known that the evening of the first day (8 P.M.) a reception will be held in the Assembly Rooms, which will be followed by a musical programme in the Auditorium. The morning of the second day will be marked by a review of the historical parade, that is to be so pronounced a feature of the ceremonies in connection with the huge display that is to go with the Hudson-Fulton celebration. Remember, that comfort may be maintained, the wise ones will see to it well in advance that hotel accommodations have been secured.

CURRENT MENTION.—

MR. HARRY B. KIRCHER, Superintendent of the Belleville (Ills.) Gas and Electric Company, has resigned. He will take a prolonged vacation before again getting into harness.

THE Baltimore (Md.) Retort and Firebrick Company seems to be getting its share of business, as the following orders on its books for new benches, etc., at the named points, go to show: Hyattsville and Cumberland, Md.; Charleston and Spartanburg, S. C.; Danville, Va.; Tallahasse, Fla.; Selma, Ala.; Smyrna, Del., and Bridgeton, N. J. In fact, with its New England business and foreign trading the Company has shipped, since the first of the year, 566 retorts, including the setting blocks for the benches. Arrangements have also been made to represent in this country a system of European vertical bench construction, respecting which due announcement will be made later.

MR. F. C. ARMSTEAD, supervising engineer of the stoker department of the Westinghouse Machine Company, who for a number of years has been located at East Pittsburgh, Pa., has removed his headquarters to the Westinghouse plant at Attica, N. Y., at which point the stokers are built.

THE net selling rate at Holland, Mich., has been put at 90 cents per 1,000 cubic feet.

MR. L. M. BELLERS, Manager and Secretary of the Orange County Gas Company, Anaheim, Cal., has sold out his interest therein to Mr. D. I. Peters, President of the Company, and a resident of Los Angeles. Mr. Bellers was asked to remain with the Company, but declined. He has arranged to take a try in another direction.

THE Dedham and Hyde Park (Mass.) Gas Company has been purchased by what may be termed local capitalists. Its new executive managers are: President, Mr. Jno. Joyce, of Andover: Secretary-Treasurer, Mr. Vincent Goldthwaite, of Wellesley.

A Gas Company Decalogue.

Compiled by MR. E. H. YORKE.

I.—Thou shalt make good gas all the time, free from all impurities, and deliver it at a proper pressure.

II.—Thou shalt keep thy works' and mains' service in good order, free from stoppages and leaks.

III.—Thou shalt treat thy servants with consideration and pay them fair wages.

IV.—Thou s alt keep thy meters in good order, and test them at frequent intervals, in order that thou shalt be sure that they register correctly.

V.—Thou shalt sell thy product at a fair price.

VI.—Thou shalt serve thy customers promptly and give them no just grounds for complaint.

VII.—Thou shalt charge off reasonable depreciation, and reserve a reasonable sum for contingencies.

VIII.—Thou shalt pay fair dividends, but shall not pay any extra dividends. Any excess in net profits thou shalt use for the benefit of thy customers in a lower price for thy gas.

IX.—Thou shalt not put any part of net earnings into betterments, enlargements or extensions of mains.

X.—Thou shalt extend thy mains where a return of 6 per cent. can be secured on the investment.

Mr. Yorke follows the Decalogue with a "log" of instructions, which certainly seem fair and appear commendable. The author titles the "Log,"

TEN SUGGESTIONS TO GAS COMPANIES.

I.—Endeavor in every way possible to avoid sudden changes in the pressure of gas in the street mains, as such changes subject the consumer to no little trouble.

II.—"Bar" street mains every year, to discover possible leaks; if such exist, are great menaces to the safety of the public, causing annoyance to all those subject to the escaping gas.

III.—Exercise utmost care in seeing to it that all street drips are not allowed to trap, thereby greatly inconveniencing the consumers.

IV.—Endeavor to find means to prevent the formation of naphthaline in the service pipe, which, if formed, subjects the consumer to much annoyance from insufficient supply,

V.—Do not allow old service pipes to remain in the ground until they become rusted out and leak.

VI.—Do not maintain excessive pressure on any part of the street main system in order to supply sufficient gas to another section where the consumption is greater. Such excessive pressure makes the burners "blow" and causes excessive gas bills.

VII.—When notice has been received that there is an odor of gas in the premises, there should not be a moment's delay in an agent of the company proceeding with the utmost despatch to the premises.

VIII.—Complaints of "poor lights" should have prompt attention.

IX.—Consumer's request for proper information should receive careful and painstaking attention, and every effort should be made to supply this information so fully and clearly that the consumer will be satisfied.

X.—Attention to these things will cause less dissatisfaction and bring much satisfaction.

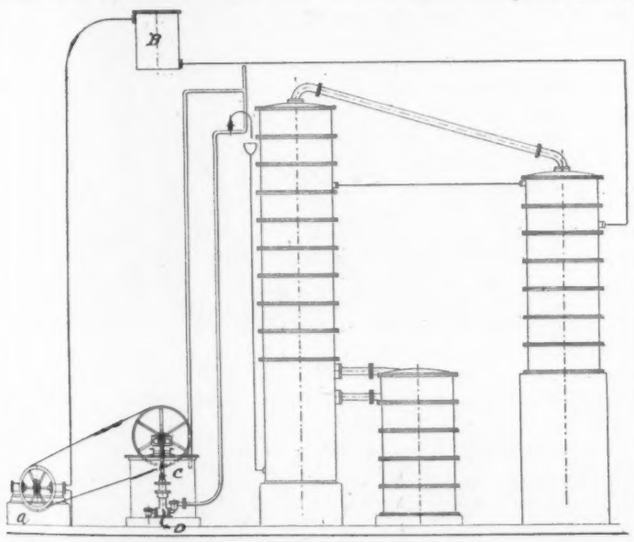
Recovering Ammonia in Small Gas Works.

By Mr. R. W. Hilgenstock, Leipzig-Plagwitz, Germany.

I have read with considerable interest Mr. Unger's paper on "Ammonia Recovery in Gas Works," in your edition of July 19th last.

I agree with most of the gentlemen, who took part in the discussion of this paper, that it is very often a very difficult matter to inject the lime into the still in a proper way, especially in smaller stills. I think, however, that we have overcome this trouble in a very simple way, and at least 3 of the plants which we have equipped with this arrangement give the very best satisfaction. The apparatus is shown in the sketch. *A* is a flywheel, steam pump for pumping the crude liquor into the feed tank, *B*, and at the same time driving a mechanical lime mixer, *C*, which again is connected with the milk of lime pump, *D*; both pumps, for liquor as well as for milk of lime, work steadily. The surplus of crude liquor flows back into the liquor well, while the milk of lime that has not been used goes back into the mixer. The supply pipe for the latter is about 1¼-inch inside diameter, and is so arranged that it will give a certain pressure on the outlet cock on the funnel, where the pipe is reduced to about ⅜ inch. By means of the cock the supply for the still can be regulated, and, inasmuch as the heavy lime is mostly on the bottom of the larger pipe, there will come out only a very light milk of lime, thus avoiding stoppage in the outlet.

As to the consumption of lime I can state that about 0.8 to 1 pound of lime will be used for each pound of ammonia that is contained in the liquor, provided, however, that the so-called volatile ammonia is driven off, before lime is added, as otherwise the lime would also bind the carbonic acid and the sulphuretted hydrogen. A still of this kind is shown in my sketch. The writer does not think it is profitable for



smaller works to install preheaters, for driving off carbonic acid and sulphuretted hydrogen; these apparatus, when built right, are very expensive things, that require a good deal of attention besides. For larger works, however, they can only be recommended, as liquor up to 30 per cent. NH_3 can be made without trouble and the freight thus saved will soon pay for the apparatus.

Gas Explosions.

[Communicated by "R."]

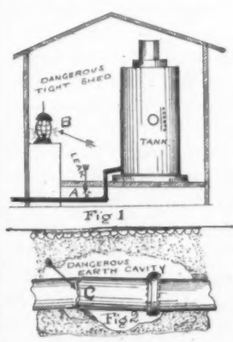
Unusual numbers of gas explosions due to carelessness have occurred of late. An employee went into a gas tank shed, not long since, carrying with him a lighted lantern; the gas outfit was making acetylene gas. There was a leak in the main pipe, as shown at *A*, Fig. 1, which caused considerable gas to gather in the shed. The latter had been made almost air-tight, which was a mistake, in that there should have been proper ventilation; but many manufacturers and owners of buildings do not think of what is needed to avoid accidents until after the accidents have happened. In this case the workman entered the gas-filled shed with lighted lantern. The glass and gauze protection surrounding the lantern prevented the gases from making immediate contact with the flame inside the lantern. However, in less than a minute after the man had gone inside for the purpose of adjusting the machine, the gases reached the lantern jet, and almost at the same time the man realized that something was going to happen, because he noticed the strong odor of gas. He turned to go out and placed the lantern on a shelf, at *B*. Then the explosion took place. The gases confined within the tight shed ignited. The workman was cast bodily outward through the door, for he was just heading that way, and his face, neck and hands were badly burned—his eyebrows were scorched off. He was in the hospital for some weeks. Of course, a workman should not go into a place like this with an unprotected light; but workmen often do things they should not do.

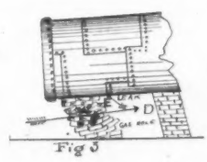
The company paid the hospital bill for the care of the careless man. On the other hand, the company was partly to blame for not having effective ventilation in the shed, and it was also at fault for not having the piping inspected for leaks.

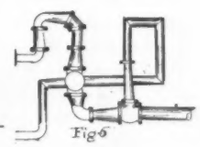
Not long ago the street pavements of a town were torn up, due to a washout of earth caused by a defective sewer, the washout happening just where some gas mains had been placed. One of these cracked, due to the settling of the supporting earth, thereby allowing the gas to escape into the cavity formed, as at *C*, Fig. 2. The failure of the gas supply caused the authorities to begin investigating. It was then that a spark from a workman's pipe got into the gases confined in the cavity and the road bed was thrown out. The workmen who were engaged on the sewer pipes, and smoking, were not aware of the proximity to the gas chamber of the gasline.

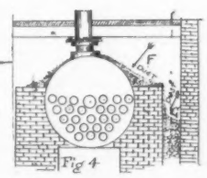
In another gas explosion a leak occurred in a confined space, due to a defective foundation, as in Fig. 3. The foundation of masonry supported a gas tank. When the forward foundation wall settled and crumbled, the tank slipped forward and downward in such way that one of the plates was strained at the joints. This made the apartment open a little, allowing the gas to escape. The crumbling walls settled in such manner that an air-tight compartment was created at *D*, and the gas was confined within this department. In course of time the tankage was overhauled. In making a resetting, it was supposed that the spark from a workman's cold chisel on the hard metal ignited the gases. The ignition was quickly followed by an explosion of the confined gases sufficiently powerful to overthrow the tank.

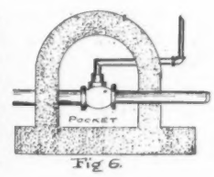
Quite a commotion was caused, although no person was injured.











Dust explosions, due to the gathering of dust particles over warm boilers and other places, have happened quite often in recent years. A case which came to the observation of the writer is shown in Fig. 4. The boiler plant was erected on the usual lines, with the exception that the upper flooring was closer than usual, and there was likewise a party wall to one side of the plant. The fine dust particles from the works settled, at *F* and *G*, over and beside the boiler in the limited space shown, the conditions being such that the engineer failed to observe this collection of fine dust. Time passed and the heated dust ignited one day, causing the bulk of the accumulation to explode like gas. The sidewall was torn out and the floor above set on fire.

Tops and sides of boilers should be examined with a view of detecting and removing any dust which may gather as time passes. Often years pass before a dangerous collection of fine dust assembles, but when the danger time arrives something may happen to seriously damage the plant.

Gas explosions often arise, due to the employment of unnecessarily complicated spstems of gas pipes. I saw one curious combination outlined in Fig. 5. When there are turns and elbows in unusual number the danger of leakage is increased. In a recent case the piping which had sprung a leak was discovered to have in it 7 joints more than necessary. When the system was overhauled this number of connections was displaced. Pockets should be avoided as far as possible, as is well known.

The dangerous pocket has been introduced more frequently since

the use of concrete. Concrete pockets are made for all sorts of purposes not heretofore thought necessary. A type of concrete pocket is shown in Fig. 6. If the pocket is made with the proper designs of doors and passages there is no danger; but practically air-tight pockets exist. Pockets to protect the pipes from cold, steam, etc., may be found, and these pockets are dangerously air-tight. When gases get to leaking the pocket fills; then if the gases become ignited through some unusual cause the resulting explosion may do much damage. Such explosions are already recorded.

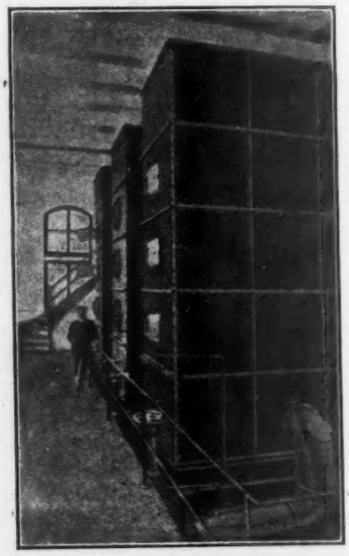
Vertical Purifiers in Germany.[1]

As the name suggests, these are practically the ordinary purifiers set upon end, the leading idea of the invention being the extension of the purifying plant in a vertical, instead of in a horizontal, direction. It has often been found, when following the generally accepted rules in calculating the size of purifiers required to deal with a given quantity of gas, that a "liberal superficial area" (as Newbigging put it) is necessary, and the consequence is a difficulty with regard to space, which, in the case of a cramped works, may easily prove insurmountable. When it is borne in mind to what a very considerable extent the newer methods of carbonization—inclined and vertical retorts, and so on—with overhead coal bunkers, have increased the gas producing power of the retort house area, it undoubtedly seems highly desirable to be able to effect a corresponding increase in the purifying power of the area available for this purpose. The writer remembers being told by a Japanese gas engineer, who was on a visit to Europe some years ago, that they had introduced inclined retorts there, not on account of the saving in wages, as they could get very good stokers for about 25 cents a day, but on account of being able to make more gas on a given area.

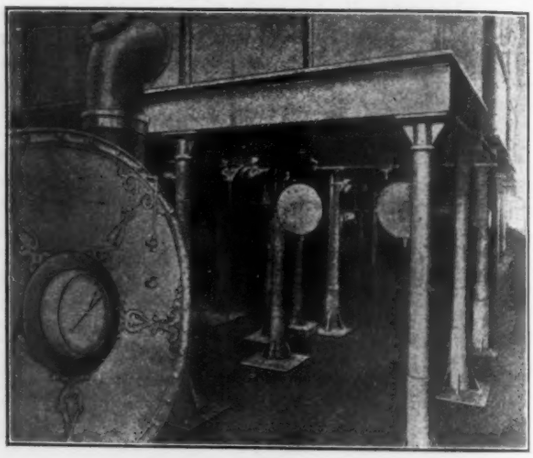
Some few years ago the late Herr Merz, of Cassel, published the results of a series of experiments he had made, and these went far to prove that more depended upon the quantity of the oxide in the purifier than on the shape or superficial area of the latter, or on the velocity of the gas, and these results undoubtedly encouraged Herr Schmiedt, the Manager of the gas works at Aschaffenburg, to work further in this direction. He found that a vessel of considerable height, but of small ground area, could exercise a purifying effect equal to a flat vessel of large area, the amount of oxide contained in the two being equal. There are, however, certain limits, as the passing the gas through too great a thickness of oxide would mean a great increase of back pressure unless some means be devised of so holding the oxide that it should be easily pervious to the gas. This problem Herr Schmiedt claims to have solved by his vertical purifier. Two parallel partitions of louvre boards hold an upright layer of oxide about 4 feet thick and 16 feet high, which is, furthermore, supported at various heights by slanting boards, to prevent its settling down to the bottom. The gas enters at the side of the box, and the space between the side walls of the purifier and the louvre boards being free, it diffuses itself over this surface generally, thence passing horizontally through the oxide, and leaving the purifier on the other side. Herr Schmiedt considers the thickness of this vertical layer of oxide, 4 feet, about as far as it is desirable to go, and is thinking of dividing this into two layers, and admitting the gas in the middle. At the top there is a partition reaching well down into the oxide, to prevent any short-circuiting. The purifiers are conical in shape at the top and at the bottom, the cones terminating in the openings for filling and emptying. The oxide is shovelled into the purifier through openings at the top, which can be closed by "Morton" lids, similar to ordinary retort lids, and emptied out through corresponding openings in the bottom, doors being also provided in the sides. These lids and doors are made perfectly gas-tight, by causing them to work against a lead ring, which is lightly smeared with tallow. This ring can, of course, if necessary, be renewed at slight expense. We have thus, with this invention, purifiers without either water seals or rubber joints—practically purification in closed vessels.

Aschaffenburg is a town of same 27,000 inhabitants, about an hour's railway journey to the southeast of Frankfort, and has a comparatively small gas works, making some 65,000,000 cubic feet yearly; but Herr Schmiedt is not one of the sort content to stick to old methods. He had the courage to be one of the first to go in for vertical retorts, 2 years ago, and these have evidently suited him well, as he is now building a second oven. Being thus an adherent of vertical retorts, he went a step further, and invented the vertical purifier, which he has patented in several countries, Great Britain included He uses

1. *Gas World.*



Vertical Purifiers at Aschaffenburg.



The Purifiers Seen from Below.

mostly Yorkshire coal, which, as it can be brought by water to within a few yards of his works, comes cheaper than German coal.

These purifiers, of which there are three, have now been in action for a period of 18 months, and in order to be able to publish working results which shall be beyond any suspicion of undue favor, the staff of the experimental gas works at Karlsruhe, belonging to the German Gas and Water Association, has been called in to make tests. This has been done with characteristic thoroughness, the report being signed by Dr. H. Bunte. As might have been expected, the effect of the purifying material—in this case, oxide— on the gas is practically the same as with any other purifier; and this is shown, in lengthy tables, to have been the case. The vertical purifiers, which are 4 feet 6 inches by 13 feet in area and about 16 feet high, supported on 6 cast iron pillars, at a height of about 6½ feet from the floor of the house, contain each some 25 tons of oxide, and have passed some 250,000 cubic feet of gas in 24 hours. As, however, Dr. Bunte's experiments show that the first purifier absorbed 98 per cent. of the sulphur contained in the gas, there is little doubt that they would suffice for a larger quantity.

From one time of changing to the next, Herr Schmiedt claims to purify 17,000 cubic feet of gas per cubic foot of oxide. The oxide he uses is a mixture of bog ore, of which he takes 3 parts to 1 part of the artificial oxide known as "Lux mass," and to lighten it he puts in about 5 per cent. of grain husks. The highest back pressure observed during these tests, which occupied a period of nearly 3 months last winter, was 4 inches, and this was explained by the oxide having got hard; in consequence of which the emptying of the purifier took 4 men 2 hours and 40 minutes, this being longer than than usual. When this occurs the oxide has to be loosened with iron rods; but, usually, the emptying of the purifier is soon done. The purifiers are solidly built of cast iron plates with planed joints, and as there are

no wrought iron covers rusting in water seals or rubber joints to keep in order, the cost of maintenance should be low.

Of course, it might be expected that in the case of what may be described as a wall of oxide, the oxide towards the bottom would, owing to the superincumbent weight of the rest of the oxide, be less pervious to the gas than that at the top, and that, therefore, most of the gas would tend to pass through the upper half, rendering the lower half useless. Dr. Bunte made several experiments to see if this were the case; but found that the oxide had worked evenly all over. Drawings have been prepared for a new set for a gas works making 4,000,000 cubic feet per day, the ground area of these proposed purifiers being only 25 feet by 10 feet.

Altogether, the advantages of this system may be summed up as a great saving in space and economy in charging and discharging. The purifiers are made by the Berlin Anhalter Machinenbau Aktiengesellschaft.

The Working Efficiency of the High Pressure Gas Plant at Dunfermline.

[An Account Presented by MR. A. WADDELL at the Sterling Meeting of the North British Association of Gas Managers.]

At last year's meeting Mr. Alex. Waddell, Dunfermline, described a high pressure plant he had installed for the supply of a district 144 feet below the gas works and 4½ miles away. The supply of gas required was estimated at 2,500,000 cubic feet per annum within the first 3 years, probably rising to 20,000,000 cubic feet per annum within 10 years. Instead of having the compressor regulated in the usual way by an attendant, the author adopted the plan (and he claims he was the first to do so) of returning a pressure from within the supply pipe, so as to automatically regulate the compressor and maintain a predetermined and always sufficient, but not excessive, minimum pressure on the district to be supplied, however much the demand might vary, thus securing the greatest possible efficiency of compressor and piping with the minimum size of plant and total cost. In the present paper, some particulars were given of the working of the plant, which was started in October last, and has worked for the past 9 months in a way that has been completely satisfactory.

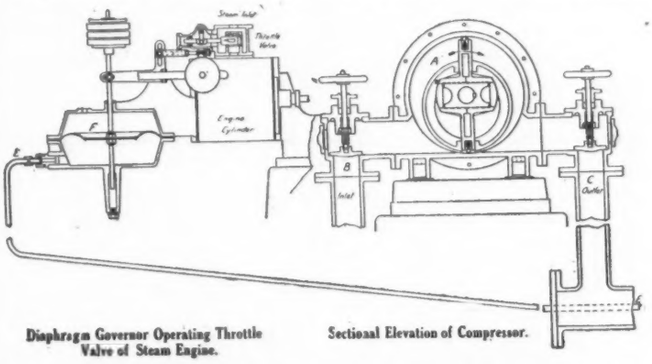
The drawing shows a side view of the principal portions of the plant erected at Dunfermline. *A* is the compressor, *B* inlet, *C* outlet. *D* is an automatic high pressure safety by-pass valve. *E* is the small return pipe, by means of which the pressure away in the area of supply is transmitted to the apparatus for controlling the speed of the compressing plant. *F* is a diaphragm controlling apparatus, the function of which is to automatically regulate the speed of the compressor in order to maintain a uniform (and predetermined) pressure in the area of supply, which pressure is introduced to the underside of the diaphragm. *G* is a combination trap, test and inspection box.

The diaphragm controlling apparatus consists of a vessel containtaining a horizontal leather diaphragm, on top of which, and fixed thereto, is a metal plate and vertical spindle. This spindle is guided in, and extended through, the top cover of the vessel, and terminates in a weight carrier. The weights which are placed on this carrier balance the pressure of the gas which is on the underside of the diaphragm, in whichever position the diaphragm may be at the moment. The vertical movement of the diaphragm and spindle is transmitted to the lever of the steam throttle valve on the engine by a suitable system of levers.

To follow the controlling action of the apparatus, assume that weights have been placed over the diaphragm requiring 6 inches pressure under it to lift the diaphragm, then start engine. The result must be that the pipes will be filled with gas at a pressure rising to 6 inches (at far end of district to be supplied). This pressure is conveyed to underneath the leather diaphragm and lifts it. The diaphragm, in turn, rises and controls steam throttle valve and compressor, so as not to allow more than the predetermined 6 inches of pressure on the one hand. On the other hand, when the diaphragm tends to fall, more steam is given to the engine, causing compressor to give a pressure not less than the 6 inches predetermined, so that a constant balance of weight over and pressure under diaphragm must be obtained so long as the compressor has power to do so. It governs not only the gas pressure in district (as does a governor), but also governs the compressor. While the weight above and pressure below are constant, it will be observed that the diaphragm must rise and fall in accordance with the steam required or demand made for gas.

In regular working, the pressure in the high pressure main over 24 hours varied about ¼ an inch.

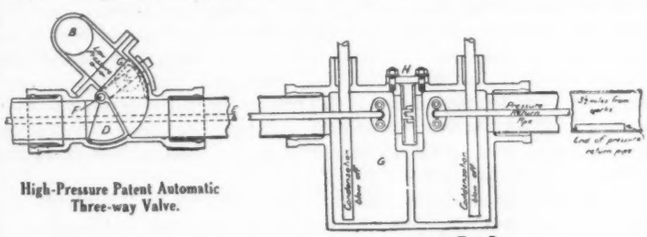
Diagram No. 1 is a record of pressure at compressor outlet during a



Diaphragm Governor Operating Throttle Valve of Steam Engine. Sectional Elevation of Compressor.

temporary obstruction (probably naphthaline) which passed away as it came, leaving no definite indication of what it really was. During its existence, all water traps were visited and found quite dry. The pressure at the supply district remained as usual, although engine had to raise pressure to 23 inches at outlet of compressor to do so. It will be evident that although any obstruction should take place and be great enough to require the full power of compressor with steam full on, the plant would still automatically maintain that minimum pressure in supply district which it was set to give, and could only fail to do so on account of an accident to, or want of power in, the compressor. This result differs widely from what occurs when we depend on a stated maximum pressure at outlet of compressor or governor, and shows how the compressor and piping combine in this form of plant to render automatically the best possible service.

D, in Diagram No. 2, is a record of pressure when cover *H* was



High-Pressure Patent Automatic Three-way Valve. Inspection Test Box.

taken off, making an opening nearly equal to the area of the pipe. The fall of pressure was 8-tenths, and when another cover was put on the pressure recovered itself, as shown at *E*. The fall of pressure at *F* followed the opening of a 1 inch and also of a 1¼-inch stopcock in main supply pipe. *G* is the record of pressure during the replacement of cover *H*.

These tests are more severe than would take place in actual practice; the largest variation of pressure is from 7 inches to 8 inches, which is not at all excessive, or such as would disturb the consumers, and is a smaller variation than is obtained with ordinary low pressure distribution.

After the plant had been working for some time, it was felt that provision should be made against any breakdown or stoppage of the compressor, and after considering all that was possible in the matter, a by-pass valve, *D*, was designed to meet the following requirements:

(1) That it should have no water or other lute, as it will have to work with a pressure up to 20 pounds, or perhaps more.

(2) That it should by-pass the moment that the initial pressure of the gasholder exceeds that at outlet of compressor.

(3) That it should shut the by-pass when the compressor was restarted.

(4) That it should not be subject to stick, and that it should be automatic and reliable in its action.

C is outlet pipe from compressor to supply district. *B* is by-pass from inlet to outlet of compressor. *D* is the moving part of the valve. It is box formed. The side view is triangular (and front, not shown, is square). It is hinged at *F*, and the bearings are at *G*. The position it is shown in is that which it occupies with the compressor standing. The dotted lines show its position when compressor is working. When the compressor starts, the first thing it must do is to raise the valve to where it is shown in dotted lines, shutting the by-pass before gas can pass to supply district. This is not obtainable in a flap or plate valve, which would open partly when the compressor started, only to allow the gas to be pumped round from outlet to inlet of pump. but would give no high pressure delivery to district. An-

other point is the moving part is held up against a face (which is unlikely to get dirty or sticky), and out of the way when compression proceeds. Then it has all its weight, if necessary, to enable it to fall and by-pass, and the full power of compressor to shut it against by-passing and hold it there; hence its reliability.

Diagram No. 2 was a record of tests made to show how the valve

Diagram No. 1.—Record of Pressure at Compressor During Partial Stoppage in the Main.

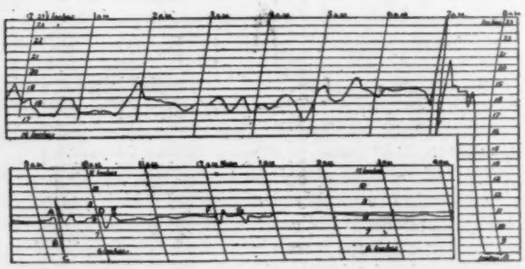


Diagram No. 2.—Record of Pressure at Charlestown During Tests.

A.—Engine stopped.
B.—Automatic valve open.
C.—Engine re-started.
D.—Cover, *H*, on test box, *G*, removed and replaced by cover with holes.
E.—Normal pressure restored.
F.—1-inch and 1¼-inch stopcocks open.
G.—Cover, *H*, replaced.

would respond to stoppage or breakdown of engine and sudden changes in consumption of gas. It would be noticed that the engine was stopped at *A*, and when pressure fell to holder pressure, it (the valve) opened at *B* to holder. Then the engine was started at *C*, and the valve immediately and automatically shut.

These pressure records, drawings and descriptions showed how the plant answered its purpose, and with what efficiency and economy. In its working there had been no trouble, and it had given satisfaction to all concerned, including the consumers, although they paid considerably more for their gas than did the people in Dunfermline. The author believed this was in no small part due to the somewhat higher and distinctly more uniform pressure that was obtainable than under ordinary circumstances.

There was just one little difficulty in the erection of this plant. It was found, after a large part of the block tin tube was laid inside the supply pipe, that there were a number of little holes in it, owing to little pieces of hard parts in the metal which did not stretch like the rest of the pipe, and as it was drawn into the supply pipe these holes were thus made. It was fortunate, therefore, that they were able to withdraw this tube at the combination water trap, test and inspection boxes and replace it with other tube, with a minimum of trouble.

Discussion.

Mr. D. Vass, Airdrie, said, that having a problem to solve as to the supply of a low-lying district, he had inspected Mr. Waddell's arrangement, and he was very satisfied with the manner in which it worked. It answered admirably to a sudden call for gas without anyone having to attend to it. He understood that Mr. Waddell had adopted a lead tube for the return of the pressure, and he (Mr. Vass) would like to know whether a malleable iron tube could not be used. He thought the by-pass valve was an excellent piece of work.

Mr. J. D. Keillor, Lochgelly, while thanking Mr. Waddell for his paper, said he expected the author would have gone more fully into working costs—the cost of compression, maintenance and so on. With regard to the by-pass valve, which, he imagined, was an idea of the authors, at Lochgelly they had an ordinary flap valve opening away from the inlet of the blower. They had little or no trouble with the blower. They had had about 18 months' experience of it, and the consumption in the district had gone up 150 per cent., and the unaccounted-for gas had not increased. The quantity of gas delivered in the past 18 months was fully 9,000,000 cubic feet, and the cost of compression was 0.68d., and the blower 0.15 d. per 1,000 cubic feet. Attendance cost practically nothing.

Mr. Napier, Alloa, spoke of the sensitive control of the pressure by means of the return pipe, and also commended the by-pass valve designed by the author of the paper. At Alloa, they had saved the expense of laying a new main by introducing a small rotary compressor driven by a 2-horse power electric motor.

Mr. Chas. W. Kraushaar, Manchester, bore testimony to the efficiency of the by-pass valve.

Mr. W. B. M'Lusky, Perth, said he was supplying a village 4 miles away by means of a Sturtevant fan, and the only cost that was computable was that of lubrication.

Mr. Waddell, in reply, said he was not prepared to give a final opinion as to the material of the pressure return pipe. As to costs, these were so low that he really could not put a figure upon them. The engine ran so slow that it required little oil and practically no attention. In this plant there was no waste. They were not running up to 60 inches and, perhaps, giving 60 inches at the far end, but they gave only the pressure that was necessary to supply the demand for gas at the moment.

The Thompson Suction Gas Producer.

Iron Age notes that in the design of the suction gas producer, Fig. 1, which is a late product of the J. Thompson & Sons Mfg. Com-

Fig. 1.—The New Suction Gas Producer Built by the J. Thompson & Sons Mfg. Company, Beloit, Wis.

pany, Beloit, Wis., the aim had been to insure continuous operation, eliminate grates and avoid dust from dry ashes. The construction is best shown in the sectional view, Fig. 2. A flanged ring attached to

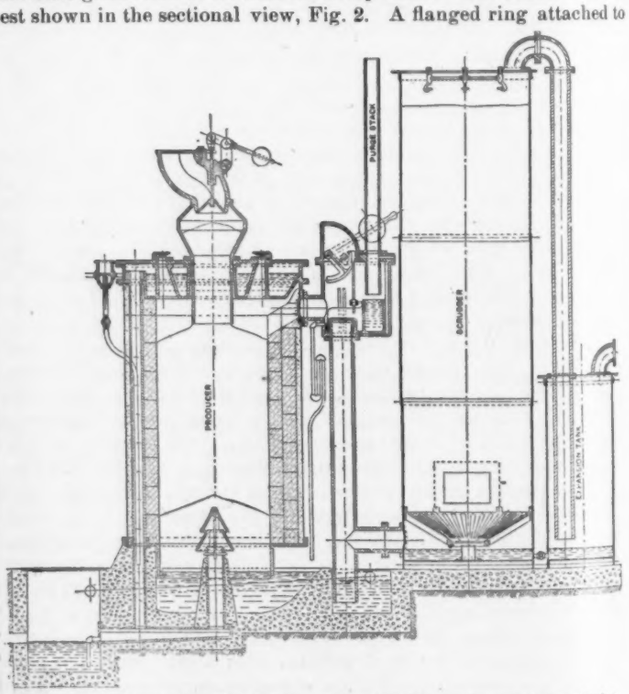


Fig. 2.—Sectional View of the Thompson Suction Gas Producer and Auxiliaries.

the bottom of the generator projects into a water filled pit over which the producer is placed, making an airtight bottom. A bed of ashes resting on the bottom of the pit and extending above the water line

supports the fuel. Air and steam admitted through a central set of tuyeres penetrate the layer and ashes and pass upward into the fuel, furnishing in a regulated measure the amount of oxygen required for combustion. Spaces between the three or more legs or piers on which the producer is supported afford openings for the removal of ashes with an ordinary shovel. Being removed through the water the ashes are wet and no dust, therefore, arises from this operation. The absence of grates simplifies continuous operation, since there is nothing to obstruct the downward movement of the ashes, which are removed in the manner described without in any way interfering with the gas producing process.

In the top of the generator, which consists of a steel shell lined with a double row of firebrick and reinforced at top and bottom with angle rings, is located a cast iron evaporator in which is generated the supply of steam introduced with the air through the tuyeres. The latter are arranged to give uniform and even distribution through the fire bed. Fuel is charged into the producer through a top charging hopper arranged with a dumping valve at the bottom and a cover over the mouth of the opening. As the gas is generated in the producer it is conducted through a pipe leading to the wet scrubber. Located in this pipe line between the two is a vent valve by means of which the passage from the scrubber may be closed and that to the vent pipe opened; thus when the valve is in its upper position the passage through from the generator to the wet scrubber is unobstructed, but when dropped to its lower position this passage is closed and that to the vent pipe is opened.

The wet scrubber through which the gas is passed for cleansing consists of a cylindrical sheet steel vessel provided with a grate near the bottom, upon which rests the bed of coke with which the scrubber is filled. Water is sprayed over this bed of coke through sprinklers placed at the top of the scrubber. Gas from the generator entering the scrubber at the bottom passes up through the wet coke, which separates the impurities from it. An airtight cleaning door at the bottom of this vessel provides means for cleaning the interior and removing the coke. Moisture gathered by the gas in its travel through the wet coke is drained off in a small drying tank, to which it is piped from the wet scrubber; the drying tank also serves to equalize the suction of the engine on the producer.

The auxiliary equipment furnished with this producer includes a portable blower equipped with pulleys for driving with a small engine or motor, or if desired by hand. Working under standard conditions at full load, using anthracite pea coal, coke or charcoal, the producer is claimed to deliver 75 per cent. of the heating value of the fuel consumed, gasifying up to 13 pounds of fuel per square foot of grate per hour. The producer is built in sizes from 30 to 300-horse power capacity.

New Design of Link Belt.

Differing in design, construction and application from the usual all-steel types of link belts, the belt here illustrated is composed of a side-bar steel link chain incased between an under scrip of rawhide and friction paper top blocks. This belt is V-shaped and is being put on the market by the Peerless V-Belt Company, and the claims for it are unusual efficiency in the transmission of power, great durability and noiseless operation.

Fig. 1 shows a piece of the belt with the casing cut away on one end to expose the chain. The continuous strip of specially prepared rawhide, forming the bottom and sides of the belt, and the friction, paper top-blocks, are held together by through rivets passing between the center blocks of the chain links and are far enough apart to allow free action of the chain around a pulley. Each of the top blocks is reinforced above and below by a steel plate or washer attached to the block by prongs. The rivets and rivet holes have flat sides to secure the block against lateral displacement. The chain side links are wedge-shape, and the sides of the top-blocks are beveled to correspond, and the assembled belt conforms to the groove in the pulley in which it runs, as seen in the cross-section view of the belt and pulley, Fig. 2. Fig. 3 shows a piece of the belt on a pulley.

All of the strain upon the belt is borne by the chain, none of it being sustained by the friction casing. Rawhide, when not subjected to strain, is very lasting, and is not susceptible to injury from dampness; its coefficient of friction is higher than that of belt leather, and it is, therefore, especially adapted to the service required in this case, since its only function is to supply friction contact. The wedge principle here adopted as a means of securing the necessary friction for

Fig. 1.

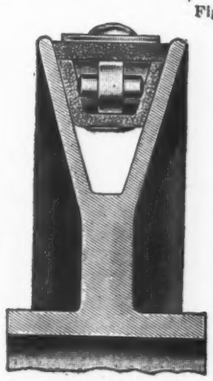


Fig. 2.

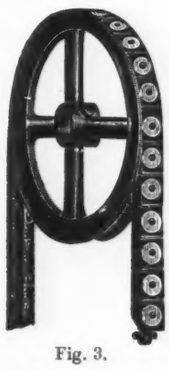


Fig. 3.

Details of the Peerless V-Belt.

transmission service only requires sufficient p ressure to give the required adhesion. This is suppled by the weight of the belt itself without the intervention of belt tighteners. The belt may, therefore, be run slack, thus reducing the tension on the driving side and so minimizing the journal friction. By experiment it has been found that a V-groove of 28° angle yields the best results with this belt, since it is at this pitch the best friction is obtained and the belt leaves the groove with practically no loss of power. It is essential that the groove be deep enough so that the belt will not touch the bottom, otherwise there would be little or no wedging effect, with consequent loss of friction.

In addition to the advantage of noiselessness, it is claimed that the V-belt is well adapted to high-speed transmission. On small pulleys it may be run at a speed of 3,000 feet per minute, and on larger ones its travel may be increased to 5,000 feet per minute. This belt is at present made in two sizes, measuring ¾ inch and 1¼ inch, respectively, across the top. Where greater power is desired it can be run in multiples. The ¾-inch belt is designed to transmit 1-horse power for every 200 feet of lineal contact per minute, while the 1¼-inch size requires about 130 feet of lineal contact per minute per horse power. These efficiencies are based upon adequate distances between centers, which, however, need be but little longer than those used for chains. Special V-shaped rims made for attachment to any flat faced pulley can be supplied, so that to install the belt a new equipment of V-shaped pulleys is not necessary.

Tests on the Effect of Temperature on the Setting of Concrete.

As an addition to the material being accumulated regarding the effect of temperature on the setting of concrete this abstract of a series of tests carried on the past year as thesis work at the Worcester Polytechnic Institute (Massachussetts) by Messrs. R. W. Crowther and L. E. Swift, under the direction of Prof. A. W. French, is given. There are numerous inconsistencies in the results, but the general effect of temperature variation is well known.

The tests were made on 5 by 5 by 12-inch 1:2:4 (by weight) blocks in compression. The aggregate was a well-graded mixture and the cement a standard brand which showed 766 pounds per square inch in tension for 30-day neat briquettes and 281 per square inch for 1:3 mortar briquettes. All blocks were mixed in a room with a uniform temperature of 70° F., using water at 65° F., and the regular interval between the gauging of the concrete and the removal to the setting temperature was 2½ hours. Forms were kept on the blocks for one week and the entire setting period in all cases was in air.

With the exception of the batch of blocks placed in the 1° F. temperature, each temperature batch consisted of 6 lots, of 3 blocks each, tested at 1, 2, 3, 4, 5 and 6 weeks, respectively. These batches were placed in temperatures of + 32°, + 36°, + 47° and + 74° F., respectively, and broken in compression immediately on removal therefrom. The first batch (— 1° F.) was more complicated. All blocks were

placed in a temperature of 1° for varying intervals and some were tested immediately on removal therefrom, while others were placed first in a 2-day 70° temperature, and then for varying intervals in a 36° temperature. The outlines of these tests, together with the values of crushing tests, are given in Table I.

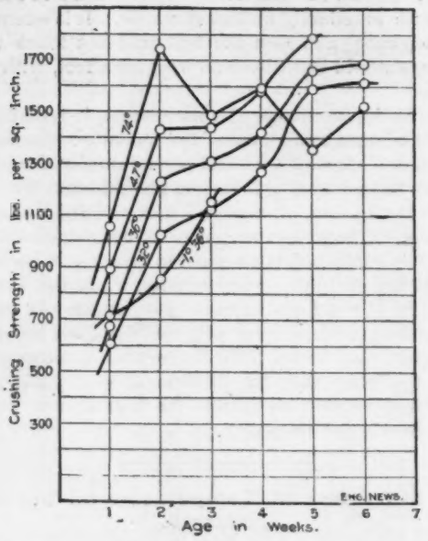
Table II. gives the averages of each of the other tests, and the whole series is graphically shown in the accompanying diagram.

TABLE I.

	Days in Storage			Crushing Strength Lbs. per Sq. Inch	
	-1°	70°	36°	Each.	Avg.
1	7	..	..	817	..
2	7	2	..	0	..
3	7	7	..	908	..
4	14	..	..	337	..
5	14	2	..	0	..
6	14	7	..	723	..
7	21	..	..	647	..
8	21	7	..	912	..
9	21	7	..	906	..
10	26	2	7	726	
11	26	2	7	679	719
12	26	2	7	753	
13	26	2	14	871	
14	26	2	14	950	858
15	26	2	14	754	
16	26	2	21	1,246	
17	26	2	21	952	1,155
18	26	2	21	1,267	

TABLE II.

Age in Days.	32° F.	36° F.	47° F.	74° F.
1 week	608	679	897	1,059
2 weeks	1,027	1,232	1,435	1,746
3 weeks	1,127	1,312	1,443	1,491
4 weeks	1,274	1,422	1,587	1,598
5 weeks	1,591	1,662	1,790	1,359
6 weeks	1,617	1,689	....	1,524



Time-Strength Curves of Concrete Blocks Under Various Temperatures.

Electric Meter Location.

[By MR. G. E. PALMER, in *Elec. World.*]

The necessity of maintaining apparatus of a delicate nature on premises not controlled by the operator has contributed largely to the unsatisfactory results attending the use of watt-hour meters, as the successful operation of this class of electrical apparatus is dependent entirely upon frequent and accurate testing.

As the subject of properly metering the use of electricity is at present one of the most important engineering and operating problems confronting the central stations of the country, it appears that a discussion of this subject will be of more than passing interest.

As the purpose of this article is more to comment on the prevailing poor conditions rather than attempt an academic discussion of the subject, it is merely necessary to touch, in a very perfunctory way, on the prime causes of meter inaccuracies.

Briefly considered, there are a number of meters on the market of standard design and manufacture that, when properly installed and regulated, measure the use of electricity with greater accuracy than will be found in any commercial measuring apparatus in general use. That these results do not obtain in ordinary practice is evidenced by the fact that a combined record of all obtainable tests gives an average of 8 per cent. loss on all speeds of meters for the entire country—results that show conclusively a lack of frequent and proper testing.

Assuming the cost of the generating equipment to be $12, and of the metering equipment $8 per kw.—figures that are practically correct for stations of moderate size—it is a wonder how the foundation or setting for watt-hour meters could have been so generally forgotten when so much ability has been brought to bear on the subject of generator locations. Both devices have rotating elements and depend upon perfect bearings and lubrication and freedom from dampness and dirt to insure their proper operation; both require the most skilful adjustment before they are placed in service and, in addition to these similar characteristics, the watt-hour meter must perform its duty perfectly through all ranges of speed and should be able to perform its regular functions when the generating equipment is not maintaining ideal conditions of potential and frequency.

For a number of years meter locations have been generally improved, but with the exception of a few of the larger companies, the general practice has been to mount the meter on a wooden board supported on a wall or partition of the customer's premises and as nearly as possible to the service entrance. Then it was demanded of the contractor that a loop be left which would enable the station wireman, assisted by a blowtorch, two kinds of tape and a few feet of flexible conduit, to complete a job of meter connection that would be a credit to the workman only until after the meter had been subjected to the regular installation and commercial test.

It is quite true that a number of central stations insist that a definite arrangement of meter leads be maintained, but when an open wire system is in vogue the maintenance of appearance in this wiring adds very materially to the cost of meter inspection.

The meter, placed on wood, is subjected to the strains due to the effect of changes in temperature and the gradual shrinkage of its base; its wires are exposed to illegal manuipulation and any attempt to give its connections an orderly appearance simply makes more delay to the operation of testing.

It surely seems that such an expensive piece of apparatus as the electric meter should have a more definite location than is ordinarily accorded it, and it is interesting to note that a number of manufacturers are in the market with devices designed to facilitate the installation, test and replacement of meters. All of the devices examined by the writer are certainly steps in the right direction. The most essential features in an arrangement for this purpose should include terminals for service and house wires that may be approached from any direction without crossing leads, and terminals to which the meter leads may be readily connected or disconnected; a base or location on which it is possible to set any meter within the probable wants of the service without making any changes in the wiring, means for testing without interfering with the wiring or the customer's use of electricity, and an inclosing box that will allow the service wires to be carried in conduit into and out of the meter so that neither the meter nor connecting wires may be altered without breaking the seal.

When the meter is provided with the above surroundings and accessories it is practicable for the meter testing force to improve greatly the quality of their work and so reduce the cost of meter testing that it is possible to make more frequent tests when they may be found necessary without increasing the cost of the department. Furthermore, meters can be quickly replaced without the use of any tool other than a screwdriver, and as tests may be made without interfering with the customer's lamps in service, the meter testing force is not compelled to work on a short hour schedule during the winter months.

It is to be noted also that the subject of energy theft ceases to be a topic of vital interest when all wires on the line side of the meters are protected by a conduit in such a manner that it is possible to obtain unmetered service only by manipulating the seals on the meter itself.

During the coming year a great deal of work will be done in improving the condition of meter location, and the next annual report of the meter committee of the National Electric Light Association in a further elaboration of this very interesting subject will probably contain much valuable information along the lines indicated above.

[Continued from Page 479.]

The Comparative Values of Various Coatings and Coverings for the Prevention of Soil and Electrolytic Corrosion of Iron Pipe.

[A paper prepared by MR. ROBERT B. HARPER, for the Illinois Gas Association.]

Functions.—The main function of these protective materials is, of course, the prevention of either soil or electrolytic corrosion of ferric structures. In the performance of this duty the preservative compounds must meet numerous general requirements. These have been clearly stated by Prof. A. H. Sexton,[1] who seems to have summed up the whole situation in the following concise manner:

1. "The Corrosion of Metals;" *Mechanical Engineer*, February, 1905.

In order that a covering of any kind may be a satisfactory protection, it is necessary that—

(1) It should be impervious to air and moisture.

(2) It should be of such a character that, should the surface be broken through, the covering material will not accelerate corrosion.

(3) It should not be liable to be chipped or broken through by any treatment which the article covered is likely to receive in work or use.

(4) It should be durable, and should not become porous, brittle, or cracked by the action of air, moisture or light or under the conditions to which it is likely to be exposed.

(5) It should not of itself produce any deterioration of the metal to which it is applied.

(6) It should be easy of application.

(7) It should be easily renewable, should the surface be broken or damaged by accident or otherwise.

The first great essential of a covering for the prevention of corrosion is that of imperviousness to water and air, and Prof. Sexton wisely lays proper stress upon its importance by placing it at the beginning of his list of the requirements of a good preservative coating.

According to our electro-chemical theories regarding corrosion, water is an essential factor, hence it is against the advance of this enemy of metal preservation that a protective coating must prepare its defense. How well and how long various types of coatings and coverings can hold out against the continuous assaults of water and its allies—namely, the electrolytes—under different conditions, are among the main subjects for consideration in this paper.

A brief discussion of the vulnerable points of coatings and coverings for iron and steel should be entered into at this time, in order that a better understanding may be had of the conditi ons underlying the immediate or ultimate failure of so-called protective materials. This procedure will enable us to more fully understand the scope and value of the comparative tests which were made upon the various coatings and coverings.

The Failure of Coatings and Coverings.—The failure of protective materials intended for the preservation of metallic structures, to fulfill their mission as preventatives of corrosion, may be ascribed to many causes:

1. Improper application of protective material, resulting in uncovered surfaces of metal.

2. Mechanical injury, resulting in an abrasion of the coating.

3. Physical or chemical action in the coating or covering itself, resulting in shrinking, cracking, peeling, blistering, pitting or other deterioration of protective material.

4. Physical or chemical action in the coating or covering induced by some factor foreign to the protective material, and resulting in shrinkage, cracking, peeling, blistering, pitting or other deterioration of the coating.

5. Presence of minute voids or fissures natural to the coating or covering, resulting in its permeability to water.

Of the foregoing causes of apparent failure in a protective material we should not lay too much stress upon the first two, which deal with improper application and mechanical injury. All coatings or coverings are more or less subject to poor treatment before, during and after application, and consequently we should be slow to condemn them when the failures are directly traceable to either of these sources. The last three causes, however, are subject to conditions over which we have little or no control. Therefore, assuming proper application and no mechanical injury of protective coating, we must let each preservative material stand upon its own merits under the conditions to which it is to be subjected.

It will be noted that the last three and principal causes of immediate or ultimate failure of paints, dips and other preventatives of corrosion imply a permeability to water or moisture, due either to minute voids, fissures or cracks normally present in a coating, or to the physical rearrangement or chemical decomposition of one or more constituents of same.

Plate 1 serves to show the appearance of most of various types of deterioration to which coatings for the prevention of corrosion are subject.

A shows a coating undergoing complete decomposition.

B gives the appearance of a paint film being broken by the formation of bubbles or blisters containing gases or solutions beneath the coating.

C is a view of a covering, through which water and electrolytes have permeated, with the result that there has been formed considerable rust, which is forcing the film away from the metal.

D exhibits the pitting effect upon a coating, produced by the decomposition of one or more of its constituents, or in some other manner.

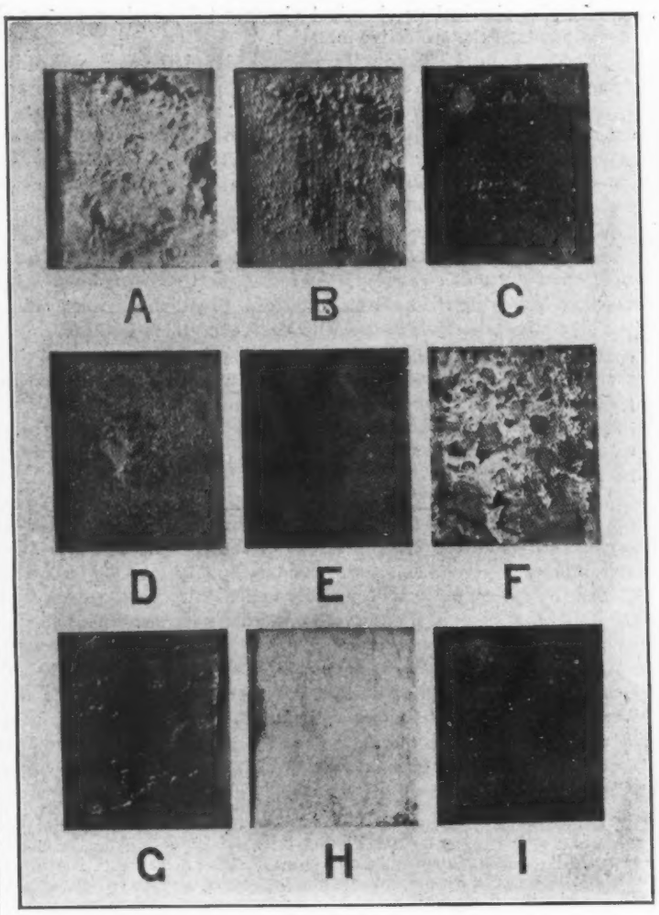


Plate 1.

E Represents a well covered metallic surface over which the paint remains practically perfect.

F shows the appearance of a coating undergoing failure by flaking or peeling.

G portrays a film of a dip compound which is shrinking from the edges of the metal that it is designed to cover.

H serves to give the general appearance of a compound which has been wrinkled badly by the action of electrolytes, etc., upon its surface.

I depicts a covering which is "alligatoring," or showing a tendency to form fissures and to crack at the surface.

According to the third cause of failure, it is not illogical to presume that the evaporation of volatile constituents in the coating would tend to leave minute voids or bubbles therein, nor is it unreasonable to imagine, according to the fourth cause, the oxidation, decomposition or solution of one or more of the constituents of a protective material, with a consequent increase in the permeability of that coating.

That many of the so-called waterproof coatings are more or less porous is a well established fact, not dependent entirely upon theory, but supported by experimental proof. Thus, in a report of a committee,[1] at the annual meeting of the American Society for Testing Materials, we find the following statement:

"The porosity of paint films appears to be due to minute bubbles in the coat. Dr. Dudley found these bubbles in investigating some black paints in films thin enough to be transparent on glass. Here the bubbles were plainly visible. The protecting film is, of course, very much thinner where a bubble occurs, and a leak would form here first, admitting moisture to the metal and causing progressive rusting of the iron and destruction of the paint."

That the foregoing explanation by Dr. Dudley, concerning the porosity of paint films, is no doubt true for many so-called protective materials, yet, according to microscopic and other investigations made by the writer upon coatings for iron and steel, it should not be presumed that the existence of the bubbles dates back to the application of the coating, or that those originally present are responsible for all of the ultimate failures. Apparently in some cases the minute bubbles, voids, or fissures are formed long after application of the

1. "Tests for Preservative Coatings for Iron and Steel." Annual Proceedings, Am. Soc. for Testing Materials; 1904.

coating, by physical or chemical changes taking place among the constituents of the protective material.

The Nature of the Tests.—Having considered the corrosion of iron from the electro-chemical standpoint, the types of coatings and coverings used as preventatives of corrosion, and the causes underlying the rapid or ultimate failure of these protective materials, we are now in a position to realize to a small degree the difficulties involved in any attempt to make tests whereby the comparative values of various protective materials are to be determined.

When the writer was asked to determine the comparative and, if possible, actual values of various coatings and coverings for the prevention of soil and electrolytic corrosion, he was confronted with a problem involving the nature of the tests to which he must subject the protective materials in order to arrive at some definite conclusions regarding their efficiencies.

Realizing that, according to our best theory of corrosion, water or moisture is one of the greatest factors in the deterioration of our metallic structures, whether exposed to soil or to electrolytic corrosion, some method was sought by which the relative porosities of given films of protective paints, dips, etc., could be determined.

A careful search through engineering periodicals, text books and other literature, failed to reveal any porosity tests to enable the experimentalist to determine the extent of the porosity at a given time and under any given condition. Like most of the other tests upon paints, the determinations of porosity relied to a great extent upon the individual powers of observation of the experimentalist and were usually dependent upon a time factor.

Among the best porosity tests described in the literature on the subject of protective compounds for the prevention of iron and steel corrosion, we find that suggested by Dr. C. B. Dudley, and described in report of a committee[1] at the annual meeting of the American Society for Testing Materials. His porosity test and results are as follows:

"On a slip of glass put a thin coating of dextrine (20 grams dextrine, 40 c.c. water, 30 c.c. alcohol) in a spot about 1½ inches in diameter. When thoroughly dry paint surface of the slip, including spot of dextrine, with paint to be tested, one or several coats, as may be desired, to correspond to the condition of use. When the paint is dry and hard, in service condition, the slip is immersed in water. If the film is porous, water soaking through will dissolve the dextrine, giving it a whitish color and causing the overlying paint to peel off."

Nearly all linseed oil paints tested by Dr. Dudley showed peeling after immersion over night. Bituminous paints withstand longer, up to 48 hours, but eventually all paints yet tested will peel.

Although cognizant of the value of Dr. Dudley's porosity test, the writer devised one of his own which not only enables the experimentalist to determine the relative degree of porosity of any given coating on the metal itself at any time, but at the same time gives him the resistance offered by a given section to the passage of electricity. The value of such a test is at once apparent, as it does not rely on a visual consideration of the coating, nor is it dependent upon the element of time and, furthermore, produces data of a mathematical nature in such a form that it is applicable to either induced or ordinary electrolytic corrosion. Owing to the relatively short time over which the comparative tests extended, some of them were consequently of an "intensive" type.

While the actual "service" test is apparently preferred by engineers, we should not hastily condemn all "intensive" tests made in a laboratory, nor should we be in great haste to draw too many conclusions from the "service" tests. Each type of test has its limitations, when comparisons are to be made between various coatings or coverings of iron pipe, and, consequently, we must be guided by the results obtained in tests, either "service" or "intensive," where all protective materials have been subjected to exactly the same conditions.

The writer has endeavored to combine tests of an intensive nature with those where the protective materials were subjected to conditions such as they were likely to meet in actual service. An attempt has also been made to conduct something in the nature of a "service" test where the conditions were very severe and unfavorable to the proper preservation of iron pipe by coatings or coverings.

The results obtained and conclusions drawn upon different types of protective materials under the various conditions of test have often been more or less ambiguous, indefinite or contradictory. On this account it will be necessary to go into a detailed account of the methods of testing and the apparatus used, as well as a minute description of the test samples themselves. However, only those tests upon preservative materials which are deemed of major importance and interest will be described.

The Electrolysis Test.—The object of the electrolysis test was to determine the comparative values of various coatings and coverings as preventatives of electrolytic corrosion of iron pipe buried in two different soils, believed to be corrosive, and under electrical conditions of as severe a character as they would probably ever encounter in actual service.

The apparatus used in the electrolysis test is shown in Plates II. and III., and Figs. 3, 4, 5, 6 and 7.

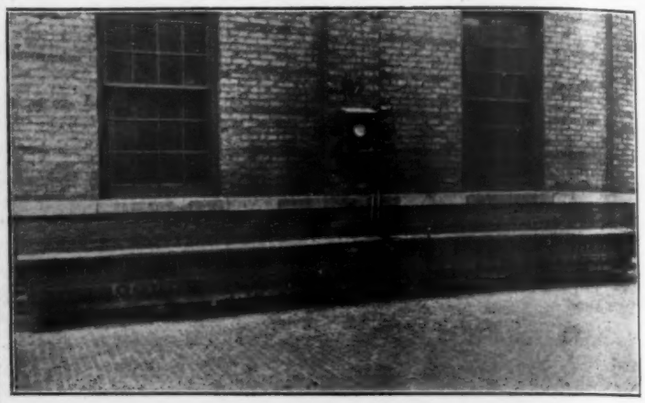


Plate II.

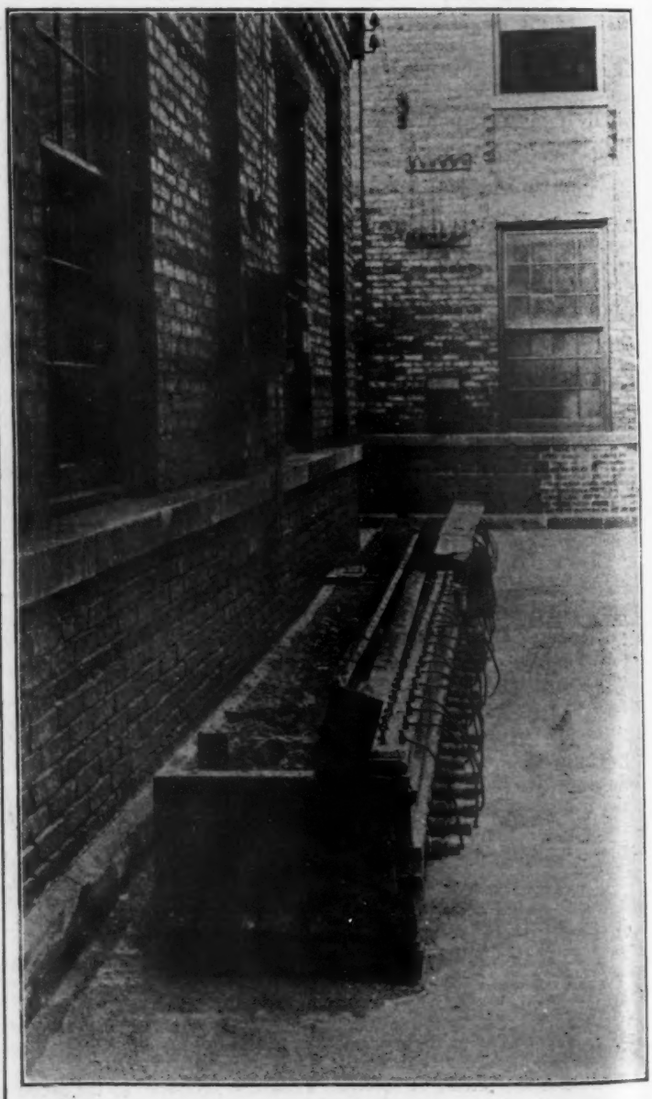


Plate III.

1. Same as former note.

Plate II. gives a general view of the boxes, ammeter, fuse, switch cabinet and wiring.

Plate III. shows the boxes as viewed from one end. In this plate the cover ordinarily protecting the binding posts appears thrown back so as to expose the connections, etc.

Fig. 3 is a diagrammatic sketch of the wiring and circuits involved in the electrolysis test.

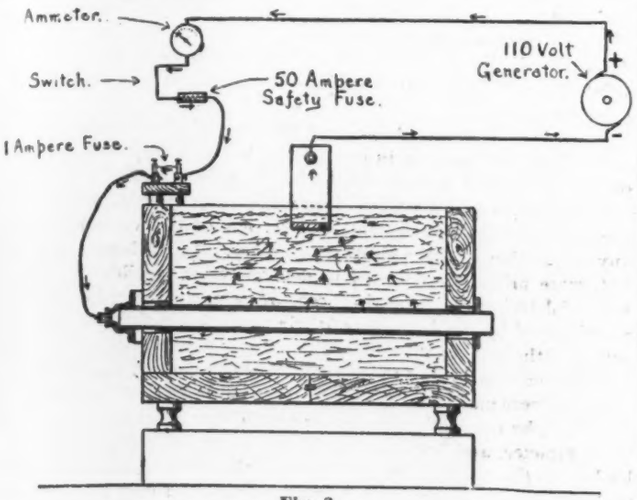


Fig. 3.

Fig. 4 shows the electrical circuits upon which certain soil corrosion tests depended.

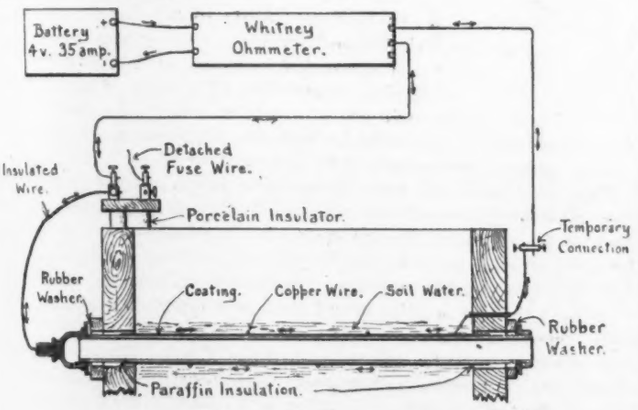


Fig. 4.

Fig. 5 portrays a front elevation of one of the test boxes.

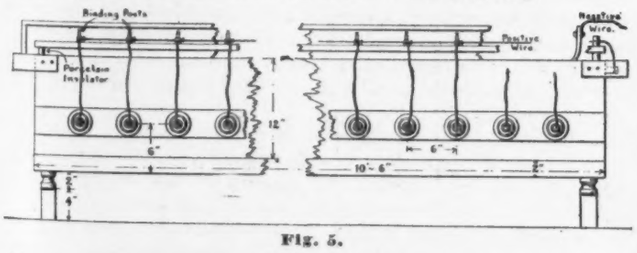


Fig. 5.

Fig. 6 pictures a cross-section view of the box shown in Fig. 5.

Fig. 7 represents a top view of test box pictured in Figs. 5 and 6.

Two heavy wooden boxes were constructed of 2-inch by 12-inch pine boards; the length over all was 10 feet, 6 inches, with a width of 2 feet and a height of 14 inches. At the height of 6 inches above the lower edge of each of the long side walls 20 holes, each 2 inches in diameter, were bored at intervals of 6 inches from center to center. Extending through these holes and projecting about 1 inch beyond the outer faces of the side walls were 20 covered test pieces of 1¼-inch pipe in the manufacture of which scrap steel was employed. The pipe were about 27 inches long, threaded at both ends. Each test pipe was held in place, at the back wall of each box, by a 3-inch iron washer held snugly against a 3-inch rubber washer, by a half portion of a coupling, and at the front wall by another iron washer, held firmly against a rubber one by a reducer connected to a short nipple of ¼-inch pipe containing solder, which held a rubber-covered, No.

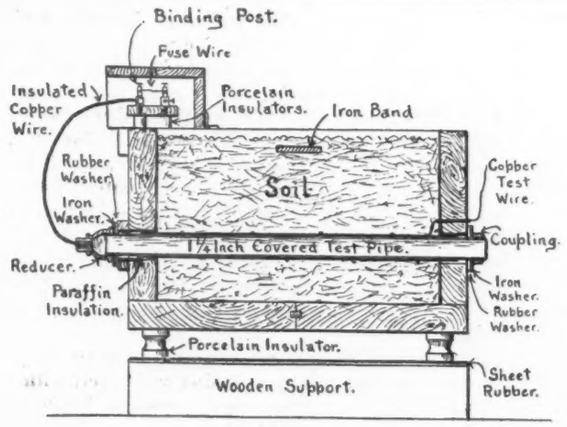


Fig. 6.

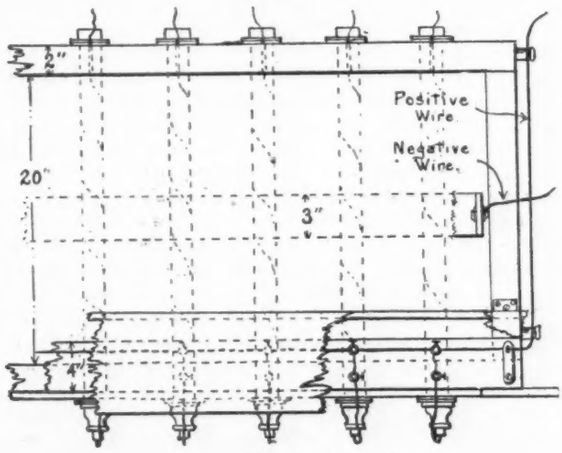


Fig. 7.

18, copper wire. The clearances between the outside surfaces of the ends of all sample pipes and the inside surfaces of the 2-inch holes through which the test pieces passed, were filled with paraffine. Around each coated pipe, exactly 4 feet of No. 20 bare copper wire was lightly wound throughout its entire exposed surface, as shown in Fig. 6. The wire was lightly held, in three places, namely, at the ends and middle, by a ¼-inch strip of insulating tape. One end of each bare copper wire passed through a glass insulating tube from the inside to the outside face of the rear wall of the box where it projected for 6 inches.

Each box was supported by 6 large porcelain spool insulators which rested (in pairs) upon three 2 foot pieces of 2-inch by 4-inch lumber, covered on the top or 2-inch sides with heavy rubber sheeting, to prevent electrical leakage or "grounding" during the test. Completely surrounding all covered test pipes in each box was soil, the top surface of which was about 1 inch below the top edges of the box.

Extending the entire length of each box, and lying about 1 to 2 inches below the top of the soil, or 6 inches above the top surface of each test pipe, was an iron band, 10 feet long, 3 inches wide, and ¼-inch thick. One end of each band curved upward in the form of an arc of 90° having a radius of about 6 inches. By means of ¼-inch holes, drilled about 2 inches from the extreme end of the curved portion, and a bolt, nut and washers, a rubber covered, heavy copper lead from the negative terminal of a 110 volt, direct current electric generator, was connected when it was so desired.

Upon the tops and at the fronts of each box was placed a finished board, 3½ inches wide and ⅞ inch thick, extending the entire length. Each board was carefully insulated from the box by means of porcelain cleat insulators, upon which it was mounted. Each board carried on top, about 1 inch from the front edge, a line of double-holed, brass, binding posts screwed into the board at intervals of 6 inches, so that they were in the vertical plane passing through the axis of each pipe sample. Two inches back of the front line of binding posts was a second series of 20 double-holed, brass binding posts, through which ran a No. 6 copper wire, leading back through an inclosed fuse, a single pole, single-throw switch, and an ammeter with a 0-200 ampere range, to the positive terminal of an electric generator previously mentioned.

Sheltering, but not in contact with, each of the boards carrying the binding posts, was a cover hinged to the end walls of the box so that it could serve as a protection to the fuses and preventative of short circuiting during rainy weather.

In addition to the apparatus already described, there was an ohmmeter, made by the Whitney Electrical Instrument Company, upon the ordinary slide wire Wheatstone bridge principle, which was used in connection with a 4-volt, 35-ampere storage battery for making determinations of the relative insulation resistances or various coatings and coverings from time to time. This ohmmeter, known as No. 912, was suitable for determining any resistance from 0 to 2,000,000 ohms, and just prior to its use in the tests described in this paper, was checked and pronounced accurate to within 1 per cent. by its manufacturers.

Other minor determinations in connection with the electrolysis test involved the use of a Weston direct-reading voltmeter, with ranges of 0-15 volts and 0-150 volts, and the employment of a Weston, direct-reading ammeter having a range of 0-5 amperes.

Theory of Testing.—The electrolysis test was based on the theory that if some coatings and coverings, which seemed to have been perfectly applied on sample pipes and were apparently in excellent condition, could withstand for 6 months the destructive influences of two different types of corrosive soil containing water, aided or induced by electrical currents driven by relatively high voltage, they might reasonably be expected to give even better results in actual practice, where the electrical conditions are ordinarily not so severe.

There are numerous cases in which high differences of potential have been found existing between service pipes and street car tracks, or other returns to power houses. For example, A. A. Knudson[1] reports drops in voltage between the mains and rails ranging as high as 25 volts. In Chicago,[2] 30 volts differences have been found, and in the "Report of the Master in Chancery on the Peoria Electrolysis Litigation"[3] it is stated that tests, made in May and June, 1894, by electrical experts, found differences of potential between pipes and rails of as much as 45 volts.

In light of the above facts, it is not unreasonable for test purposes to subject pipe coatings and coverings to potential differences considerably above those which have been found in actual service conditions. The reason is almost self-evident, for every competent engineer desires that the materials used in his structures shall be able to withstand strains and stresses much greater than the maximum ones which he believes will be encountered under ordinary working conditions.

On the assumption that the soil constituents, such as water, mineral matter, gases, etc., either singly or together, induced or not induced by a high electrical potential, act upon a given coating or covering in a chemical or physical manner, rendering it pervious to water, it was deemed possible to learn of this increasing permeability and the relative degree of same by means of a bare copper wire lightly wound about the protective material on a pipe which was completely surrounded by wet soil.

Fig. 4 serves to show in a diagrammatic way how the bare copper wire was believed to act in conjunction with a conducting film of soil water to form a contact virtually existing over the entire outside surface of each coating, the other side of which was adhering to the metallic pipe. It also illustrates the general scheme of the circuits and apparatus involved in the soil test.

Description of Soils.—Two different types of soil were used in the electrolysis test. The first soil was removed from the ground surrounding some gas pipes found in bad condition near the corner of Sacramento avenue and Lexington street, Chicago, Ills. It was found to contain both blue and yellow clays as the principal constituents, with which were mixed sand, gravel, fragments of ordinary building brick, glass, crushed rock, wood and pieces of plaster. The soil, as might be surmised from the preceding description, was a fair sample of the filled ground so prevalent in and about the city of Chicago. This clay-like, conglomerate soil, prior to its use in any test, was found to contain .1169 per cent. of water soluble matter, of which .037 per cent. was of an organic nature. Tests made upon the water soluble constituents showed them to consist mainly of carbonates, sulphates, chlorides and other soluble salts of calcium, iron, alumina, magnesium, sodium and potassium.

The second soil consisted mainly of fine ashes or cinders resulting from the combustion of soft coal beneath the steam boilers of one of the plants of the Peoples Gas Light and Coke Company, Chicago. This soil was found to be much more porous, and hence a much poorer retainer of water than the clay. It showed before its use for test purposes a water soluble group of constituents of .8183 per cent., of which .103 per cent. was volatile and combustible. The cinder soil constituents soluble in distilled water consisted mainly of sulphates, carbonates, chlorides and other soluble salts of calcium, iron, alumina, magnesium, sodium and potassium. The soil water was distinctly alkaline. The cinder soil itself contained many insoluble sulphides, which liberated considerable sulphuretted hydrogen in the presence of acids.

Methods of Testing.—After a set of prepared pipe samples had been carefully put in position in one of the boxes, a duplicate set in the other, and both of them covered with the soils, a preliminary series of tests was made over a period of approximately 1 month, during which time the coated test pipes remained buried in the wet soils, without any connection with the electric generator. As has been stated, these tests were primarily designed to determine, if possible, the relative rates of deterioration of various coatings and coverings for iron pipe, as evidenced by the decreases of their insulation resistances under the action of the soil constituents.

The determinations of the insulation resistances of any given pipe covering were made with the ohmmeter and storage battery previously described, by connecting the battery with the terminals provided on the ohmmeter, and from the latter instrument connecting one of two leads with the copper wire surrounding the coverings, and the other with the front binding post holding the insulated lead from the pipe, as shown in Fig. 4.

The resistances obtained by this method were, of course, not highly accurate, owimg to a variable contact of the bare copper wire with the surface of the coating, yet, owing to the fact that the soils were kept wet, the result obtained on any covering was practically the electrical resistance of about 1 square foot of that covering between the surface of the pipe on one side and a film of water on the other. However, the main object sought was the collection of some data which might give some idea of the comparative resistance of various coatings and coverings to deterioration by soils.

Tests were made with the ohmmeter at intervals of two or more days over the entire period during which the samples remained covered by the wet soils. Immediately after the completion of the preliminary series of tests on the effects of soil, 5 of the test pieces, which had shown up poorly, were removed from each box and replaced by 2 sets of 5 pipe, 10 in all, covered with new types of coatings. The leads were then connected to the positive and negative sides of a 110-volt, direct current generator, as shown in Fig. 3. Under these conditions, which were conducive to the corrosion of the pipes by electrolysis, the test pieces were kept for a period of over 7 months, or from August 26th, 1907, to April 11th, 1908. During this time the soils were kept in a moist state.

One ampere fuse wire, when blown, was replaced by 3 ampere fuse wires, and the total current from both boxes passing through the coatings and coverings on all 40 test pipes was never allowed to exceed 50 amperes, or the limit of the inclosed fuse shown in the circuit appearing in Fig. 3.

On April 11th, 1908, just prio to disconnecting the boxes from the electrical circuit, the current flow from each pipe, through its covering, to the soil was determined by means of the Weston ammeter previously described, by connecting the terminals of the instrument to the binding located directly over the sample being tested. A Weston voltmeter was also used, to determine the difference of potential between various parts of the apparatus. Upon completion of the foregoing determinations, the soil was very carefully removed, the boxes were taken apart, and the test pieces labeled and examined.

From July 7th, 1908, to December 29th, 1908, a second electrolysis test was run under practically the same conditions of soil, moisture, weather, etc., as in the first test. The main difference between the two tests lay in the fact that the types of coatings and coverings tested were different in each case, and that the second test was not preceded by a preliminary one involving the use of bare copper wire in order to obtain results upon the variation of insulation resistance due to the action of soil.

Both tests were conducted in such a manner that the average total current flow through both boxes was approximately 5 amperes throughout the period of 6 months.

The Porosity and Resistance Tests.—The object of the porosity and resistance tests was to determine the comparative values of various

1. "Electrolytic Corrosion of Water Pipes at Bayonne, N. J.;" A. A. Knudson. *Eng. News*, Nov. 17, 1904, p. 427.
2. "Report of Master in Chancery on the Peoria Electrolysis Litigation." AMERICAN GAS LIGHT JOURNAL, July 1 1901, p. 6.
3. "Report of Committee on Electrolysis." Proc. Amer. Gas Institute, 1906.

coatings and coverings for iron pipe under the influence of practically pure water, water saturated with the constituents of carburetted water gas, Lake Michigan water, wet clay, cinder soil, loam soil, dilute solution of sulphuric acid, dilute solution of ammonia, dilute solution of hydrogen peroxide, dilute solution of sodium chloride and electrical currents under low voltage passing to or from these compounds. In addition, the object was to determine the comparative values of various wrapping materials, such as cloth or paper, in conjunction with a paint, dip, or other preservative compound, and also the effect of the condition of the surface of a metallic article upon the material with which it is covered.

Description of Apparatus.—The device, with which most of the data were obtained in the porosity and resistance tests, was especially designed and constructed for this purpose by the writer. This instrument will hereafter be referred to as a porosimeter. Plate IV. shows

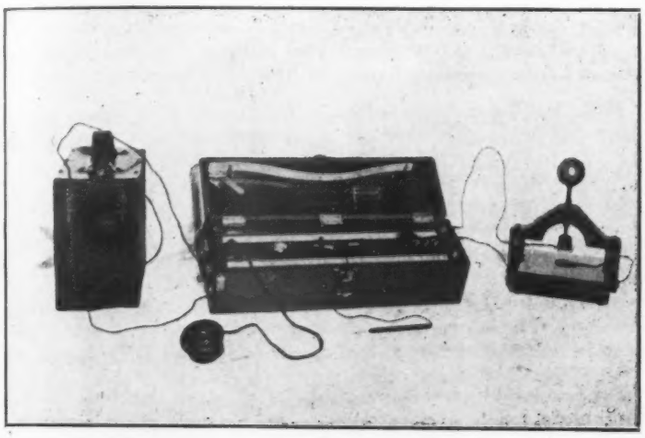


Plate IV.

this piece of apparatus at the right, connected to the Whitney ohmmeter which, in turn, is electrically connected to the 4-volt storage battery. The upper disk of the porosimeter is shown in a raised position similar to that which it occupies wher a sample is inserted between the upper and lower plates for the determination of the resistance of a given section of any sample. Sheet metal, cloth or paper samples coated on one or both sides with some preservative compound may be tested in the porosimeter. All the samples tested were 3 by 5 inches, and were uniformly covered with some preventative of corrosion on each side of the test piece over an area of 3 by 4 inches.

The porosimeter, shown at the right in Plate IV., consists of a porcelain plate mounted upon a finished piece of oak, about 8 inches square, which rests upon 4 hemispherical rubber feet. Arching over this plate is an oak yoke holding at its apex a glass tube in a vertical position. Free to move, through this glass tube extends a smaller glass tube, at the top of which is mounted a brass ball weighing 1 pound, and at the bottom of which is a somewhat cylindrical body of solid rubber. The under side of the rubber is fastened to a smooth, circular metal plate of an alloy of lead and tin, having an area of exactly 1 square inch. To this plate is connected an insulated copper wire, carefully insulated from the rest of the apparatus by a glass tube in the side support of the yoke. Directly beneath, and concentric with the upper and movable plate, is a lower and fixed disc of the same material and area, mounted rigidly upon the porcelain plate. To this lower disc is also fastened an insulated copper wire passing through the side support, opposite to the first mentioned one, by means of a glass tube, as in the first case. The 2 wires leading from the fixed and movable discs end in U-shaped contacts to fit the binding post terminals of the ohmmeter.

Other apparatus used in the porosity and resistance tests consisted of a number of rectangular glass dishes, 8 inches long, 4 inches wide, and 4 inches deep. In these dishes were held the solutions or wet soils in which the coated or covered samples were allowed to hang. For the work on the effect of electrical currents passing to or from any given preservative compound, some Edison, Type V., cells were used.

Theory of Testing.—It was presumed that, given a film of a preservative paint, dip or other coating, which was free from abrasions and fulfilled its function of covering perfectly a piece of metal, determinations of its permeability to moisture at various times, and under different conditions, would be very valuable in deciding its probable value as a preventative of corrosion.

As has been stated under the heading, "The Failure of Coatings or Coverings," so-called preservative materials are subject to deterioration and ultimate destruction by physical or chemical actions between the constituents themselves, or between the constituents and other agents, such as the metal covered, air, moisture, acids, alkalies, salts, etc. Deterioration of a coating or covering from one or more of these causes is recognized by shrinking, cracking, peeling, blistering, pitting, or other symptoms of chemical or physical changes in the paint film. Anyone of these symptoms, when displayed, is probably good evidence that the coating involved is pervious to moisture, and that any natural minute voids in the paint film have been augmented by other voids or fissures, minute or otherwise, resulting from the changes.

Granted that the electrolytic theory of corrosion is correct, it is manifest that moisture and electrolytes must be kept from the surface of a corrodible metal, and that any coating or covering which is initially permeable to water, or ultimately becomes porous, loses its power to preserve iron about as rapidly as its porosity increases. The porosity is dependent upon the natural or initial voids in the coating, together with those voids or fissures formed by subsequent chemical or physical action among the constituents and, hence, determinations of the rate at which the permeability increases may be made by noting the change in conductivity or resistance of a given section of a film as the increasing number of voids or fissures become filled with a solution having a conductivity differing greatly from that of the constituents of the preservative material.

As a rule, the so-called preventatives of corrosion are initially insulators; substances of high electrical resistance or low conductive power. The solutions which permeate through the coating have, on the other hand, low resistances and hence high electrical conductivity. The porosimeter previously described was designed with the view of determining the relative porosity of any film in such a manner as to give data of a mathematical nature, independent of the usual visual observations, which are too often deceptive.

In order to illustrate the manner in which the porosimeter is believed to operate, the diagrams in Figs. 8, 9, 10, 11 and 12 are shown. These diagrammatic drawings include only those types of deterioration of paint films which are not readily seen by the naked eye, but are easily detected by the device shown in Plate IV.

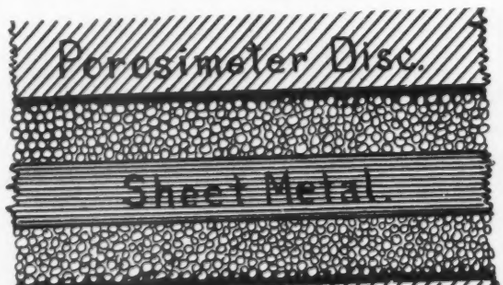


Fig. 8.

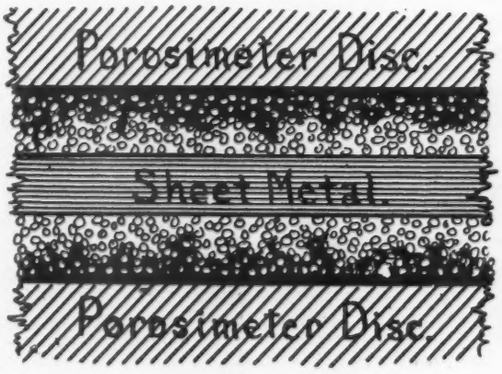


Fig. 9.

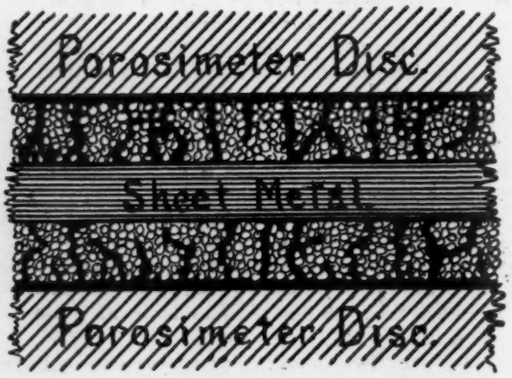


Fig. 10.

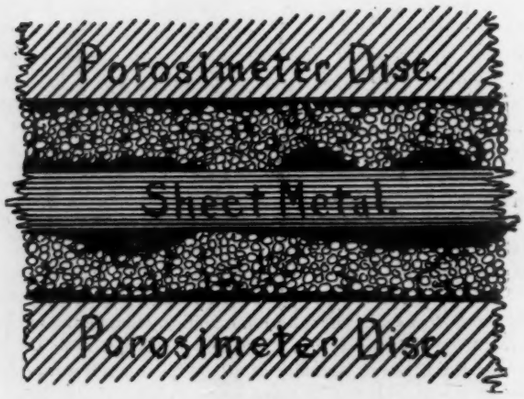


Fig. 11.

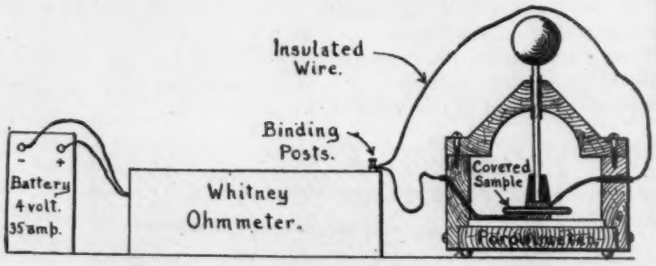


Fig. 12.

In the foregoing figures the constituents of the coatings have been represented by small circles, while the voids between them, containing moisture, have been shown in black. All figures are sectional views of a piece of sheet metal covered on both sides with a film of some preservative compound. These covered samples are presumed to have been taken from water in which they had been immersed for some time, the surface moisture removed, and then placed between the water moistened metal discs of the porosimeter in a manner to be described subsequently.

Fig. 12 gives, by means of a diagram, the general principles involved in a porosity or resistance test of a piece of metal covered on both sides with a film of preservative material containing voids filled with an electrical conductor in the form of water containing an electrolyte.

Fig. 8 represents a good coating, not containing volatile constituents or serious voids, which is practically impervious to water, and has not had its porosity increased by any possible rearrangement of the constituent particles, due to physical or chemical causes. It is manifest that the conductivity of the section bounded by the upper and lower disc is practically the same as that obtained prior to the immersion in water, for no water has penetrated into the main body of either film.

Fig. 9 shows a coating which has lost some of its initial constituents by volatilization or decomposition, and hence contains at the start more voids than the coating shown in Fig. 8, but is not subject to fissures, cracks or blisters. It is readily seen that the change in conductivity in this case is greater and more rapid than that in the first example.

Fig. 10 typifies a coating which, by chemical or physical means, has become minutely fissured or cracked, thus admitting moisture wholly or part way to the metal. This type of deterioration would, of course, probably show even greater and more rapid increases of porosity than the first two examples cited.

Fig. 11 illustrates a coating which is subject to minute blisters and to peeling or loosening from metal. It may be ascertained by reference to Fig. 11 that the conductivity of a given section between the upper and lower discs is rapidly increased in number and size of blisters, which may be filled with water, gas or rust, and stretch the paint film, thus producing greater permeability of same to moisture.

(To be Continued.)

Items of Interest
FROM VARIOUS LOCALITIES.

THE voting at Waverly, Ia., as to whether or not Jos. J. Donelan and associates should be granted the right to construct and operate a gas works there, was so pronouncedly in favor that Mr. Donelan will be heard from in the gas works' construction market forthwith.

IT is estimated that the changing over, by the U. S. Steel Corporation, from steam engine derived power to gas producer operated engine power, will take 5 years or more to complete. There is very little doubt that the Corporation has determined to supersede the steam engine by the gas engine in all possible departments of its plants.

GEN. SUPT. CLARK, of the fuel division of the Peoples Gas Light and Coke Company, of Chicago, and a great success he certainly has made of such administration, is out with an offer to place a modern Double Economy Gas Range, all connected up, in consideration of a cash payment of $2 and $2 monthly thereafter, until the range is paid for.

THE Gas Machinery Company, of Cleveland, O., has been awarded the contract for the construction of a 48-inch ammonia concentrator, for the recovery of volatile as well as fixed ammonia, by the Denver (Col.) Gas and Electric Company. Meantime Mr. A. F. Traver, Gen. Supt. of the gas division of the Denver Company, is tightening up loose ends generally in and around the plant to thoroughly fit it for the increased business that the Company is bound to have this winter. Yes, "bound" is the correct word to describe it, for even now the demands of the consumer are well in advance of any like calendar-time in the Company's records.

MR. D. R. RUSSELL has evidently been putting in some time on study during the year, for we notice in the United States Patent Register of recent date that early this month (the 4th inst.) there was issued to him patent protection (No. 930,494) respecting a new design of vertical retort bench, which has in general appearance some resemblance to the benches of the Dessau system. The distinguishing features of the Russell system are certain series of combustion chambers arranged throughout the height of the vertical retort, but in horizontal planes. Under this planning any section of the retorts may be given the benefit of greater or lesser heat, or be largely deprived thereof. All of the combustion chambers have a common take-off.

THE authorities of Woodstock, Ills., have granted a franchise to the United Gas and Electric Company to supply gas in Woodstock for a period of 50 years. It is agreed upon that the gross selling price shall not exceed $1.10 per 1,000, and the net, on payment within 15 days, shall not exceed $1 per 1,000. It is also of record that the Company must commence the laying of mains within 3 months from the granting of the ordinance, that 2 miles of same shall be laid within a year, and that the city shall be entitled to use, for any purpose it may see fit, each year a volume of gas not exceeding 100,000 cubic feet.

MR. J. D. KUSTER, who succeeded the late Mr. Harry Edwards as Manager of the San Jose (Cal.) Gas and Electric Company, has assumed his duties in that connection. As an earnest of his way of doing things, when interviewed on that matter by a newspaper reporter, modestly replied that his whole aim would be to continue the agreeable relations obtaining between the Company and the people of San Jose, and to steadily improve the service. Well said, Mr. Kuster.

THE Perkasie (Pa.) Council has assented to the proposition of the Highland Gas Company, whose proprietors propose to manufacture and distribute gas there and in the settlements of Sellersville and Quakertown.

MR. J. D. TAYLOR, JR., Manager of the Wausau (Wis.) Gas Company, has completed plans for extensive improvements on the plant thereof, being led thereto by the rapidly increasing output. The benchwork division of the construction has been awarded to the Gas Bench Construction Company.

A CORRESPONDENT in Utica, N. Y., forwards us the following regarding the proposition to establish a gas plant in Carthage, N. Y.: "That Carthage will soon have a modern gas plant is a reality at last, after several fruitless attempts in the past years to start one. The Village Board of Trustees were favorable at their last meeting to the granting of a franchise, providing the terms of the agreement met the approval of the corporation counsel. William R. Clark, of Watertown, applied for the franchise and stated that he had the money in sight and a Company ready to be organized if the permission was granted. It is his plan to erect and install a gas producing plant with a capacity of 100,000 cubic feet of gas per 24 hours, all the work of installation of the system to be done under the direction of the village. Mr. Clark will furnish gas at $1.50 per 1,000 cubic feet, with 10 per cent. discount for cash. For the privilege of the franchise Mr. Clark agrees to pay annually to the village $\frac{1}{16}$ of 1 per cent. The terms of the franchise are said to be very fair and equitable and will no doubt be approved by the village Attorney. Mr. Clark will seek a franchise from the village of West Carthage. When the two franchises are obtained he will appear before the Public Service Commission to obtain its permission, which in all probability will be granted. Immediately thereafter the construction work will be started. It is Mr. Clark's desire to have the plant in operation by late in the autumn. Two or three sites have been looked over and everything is in readiness if the necessary permissions are granted."

THE residents of Port Norfolk, Va., are anxious that the Portsmouth (Va.) Gas Company shall extend its mains to and through their territory. Superintendent Ferguson, of the Company, asserts that his superiors are willing to go to Port Norfolk, but not until the officials of the named place are willing to give them some reasonable protection or encouragement in the shape of a suitable franchise agreement.

ABOUT a fortnight ago the Boston (Mass.) Consolidated Gas Company made its third distribution to its employees in accordance with the profit sharing plan adopted in 1906. This time the payment amounts to $48,926, equal to 9 per cent. on the earnings of 638 employees for the year ended June 30th last. Since the scheme has been in operation the Company has paid to its employees $118,737, the premium each year being calculated at the like rate as the dividend on the stock. For the fiscal year just closed this was 9 per cent., against 8 per cent. in 1908, and 7 per cent. in 1907. In the operation of the plan, which was the initial of its kind in this country, the amount credited employees each year is invested in the stock of the preferred class of the Massachusetts Gas Companies, which becomes the absolute property of workmen. On balances not invested the Company allows 4 per cent. interest.

WITH the bills sent out by the Spencer (Mass.) Gas Company for gas consumed during the previous July, the following announcement was also sent: "On and after July 1st, 1909, on bills rendered August 1st, 1909, the gross price of gas will be $1.80 per 1,000 cubic feet, with the following discount, if paid on or before the 10th of each month:

"For the first 2,000 cubic feet, 20 cents discount; net $1.60. In excess of 2,000 cubic feet, 40 cents discount; net $1.40. To all customers owning and operating a gas range, 10 cents extra per 1,000 cubic feet will be allowed on the above schedule, making the respective rates $1.50 and $1.30. All prepayment meters will be adjusted at $1.60, net. A minimum charge of 50 cents per month will be made for each meter, if less than 400 cubic feet are burned. This includes prepayment meters."

THE Chicago syndicate which formerly secured a franchise for the construction and operation of a gas plant in San Angelo, Tex., recently appeared before the San Angelo City Council and secured an extension of the limiting period within which the plant should be in actual operation.

AN exhibition of cooking by gas was a feature of the International Interdenominational Fair which was held on the Physio-Medical College grounds, Indianapolis, Ind., between the 16th and 21st insts. A made kitchen, installed by and under the direction of the Indianapolis Gas Company, in which demonstrations of how to cook by gas were carried on at regularly stated times, day and evening, by competent demonstrators, really attracted the greatest attention of the average visitor to the Fair. The Welsbach Company also maintained a very handsomely fitted out booth, which was capably "manned" by urbane clerks. The grounds were for the best part illuminated by means of gas arcs. It should also be noted that the gas used in connection with the grounds and buildings was furnished by the Indianapolis Gas Company, which made no charge therefor.

"BECAUSE, as he alleged, agents of the Grand Rapids (Mich.) Gas Light Company repeatedly cut out of operation a gas regulator attached to the house side of meter in his premises, Mr. Charles L. Slade began suit against the Gas Company to restrain it from interfering with the regulator or from cutting off his supply of gas. A temporary injunction was ordered issued. As set forth, Slade, unknown to the Gas Company, had put on the meter connection an automatic valve of the type generally used in such cases. The Company's meter reader, when he first saw the device, just opened the intercepting valve to its widest, and Slade, later on, or some weeks after he placed the device, discovered 'the readjustment' and refused to pay his bill for the quarter ended March 31. The Company notified him it would shut off the gas altogether, hence the injunction proceedings. The case will come up in the regular way during September, possibly before.—W. F. M."

MR. DAVIS SKINNER, formerly of Shreveport, La., has been appointed to a responsible position on the staff of the Waterloo (Ia.) Gas Company.

BY agreement the artificial and natural gas interests, and the electric light interests as well, of Johnstown, Pa., have been consolidated. Hereafter the combination will be known as the Citizens Light, Heat and Power Company, with the following executive management: President, C. S. Price; Vice-President and General Manager, J. C. Ellis; Secretary and Treasurer, C. E. Campbell.

MR. F. V. ROYCE, writing from Beatrice, Neb., under date of the 17th inst., incloses the following: "The State Railway Commission has approved the application of the Gage County Gas Light and Power Company, of this city, to issue refunding bonds for the purpose of refunding its bonded indebtedness, after a full hearing on the merits, over which argument was made last week. I presume your readers generally know that, through recent legislative enactment it is necessary for corporations to secure permission from the Railway Commission prior to the making of new stock or bond issues. A special election will be held next Monday (the 23d inst.), for the purpose of submitting to a vote of the people the question of authorizing the Mayor and City Council to extend the franchise of the Gas Company from October 8, 1926, to August 15, 1934. If our people vote in favor (and there is every good reason for asserting that they will) of extending the franchise from its original date to the one specified, the Company will be enabled to secure ample funds to make the needed generating and distributing plant enlargements and extensions. Indeed, the rapid increase in its business makes betterments absolutely necessary, and I make no doubt that it can add at least 50 per cent. to its output by a judicious plan of putting its pipes into and through new territory. Gas works contractors should keep their attention on the result of this election.

MR. J. G. DIFFENDERFER, formerly Superintendent of the Steelton (Pa.) gas works, until that plant was taken over by the Harrisburg (Pa.) Company, and who remained in the service of the latter up to the 9th inst., has entered the employment of the Detroit Company.

"B. W.," writing under date of the 12th inst., inclosed the following: "A statement of the earnings of the Cleveland Gas Light and Coke Company and of the Peoples Gas Light Company, on account of gas sold by each for the half year ended July 31st last, shows continued shrinkage. Under the artificial gas ordinances the city is paid 6½ per cent. of their gross incomes, which sum is payable each 6 months, and statements respecting quantities must be handed in Jan. 31 and July 31. These statements for the first half of 1909 have been received and show that the Cleveland Company's gross was $293,000, those of the Peoples having been $70,649.11, the royalties being respectively $19,050.89 and $4,563.18, or a total that is $1,078 lower than any predecessor report shows. The falling off is, of course, attributable to the introduction of natural gas. In August, 1903, the Cleveland Gas Light and Coke Company turned $40,543.10 into the treasury for the prior 6 months, and that was the largest return ever made by it to the city, and the highest return by the other concern was $10,758.29. A year ago the payment by the old Cleveland Company was $23,906.88; by the Peoples Company, $7,174.84. Since 1893, when the provisions for this tax were fully formulated, the city has received $1,151,819.78. Up to 1900 the money received by the city from the Companies was put into a special fund set aside for new city hall purposes. In 1900 the ordinance making this provision was changed and the money was afterward spent for other city purposes. Most of it has gone into street lighting and a considerable portion has been spent in street cleaning as well."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHARLES H. WADELTON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
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MONDAY, AUGUST 23, 1909.

The Market for Gas Securities.

The city gas share market was weak and strong, in spots, or shades, since last writing, and the situation is in consequence decidedly a mixed one. Of course, the figures are formed on market conditions without any particular feature, other than demand and supply to govern. So it would seem that Consolidated, which sold off 5 points, and Brooklyn Union, which sold up 2 points, is not yet ready for the readjustment that is underway, whereas a dividend of considerable amount can be looked forward to in Brooklyn Union. The latter is, at noon to-day (Friday) 147 to 150; Consolidated is 142½ to 143.

The general gas share market is strong, notably the Massachusetts Companies' issues, the preferred of which has crossed 91.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies,	*Capitol.*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$73,177,000	100	142⅜	143
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	155	165
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101⅛
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	147	150
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	200,650	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	1¼	1 ⅝
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	90	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	73	73½
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,660,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	29,500,000	100	92	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,682,750	100	90½	91
Preferred	3,026,500	100	75½	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,000,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	861,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede Gas Co., St. Louis	10,000,000	100	104	105
Preferred	2,500,000	100	—	98
Bonds	10,000,000	1,000	104	—
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,370,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	350,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	65	65½
Preferred	25,000,000	100	90¾	91
Montreal Gas Co., Canada	2,000,000	100	218	218¾
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	115½	116
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	100	102
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	90	95
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	100	104
Washington (D. C.) Gas Co.	2,600,000	20	363½	367½
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas Co.	600,000	50	220	—

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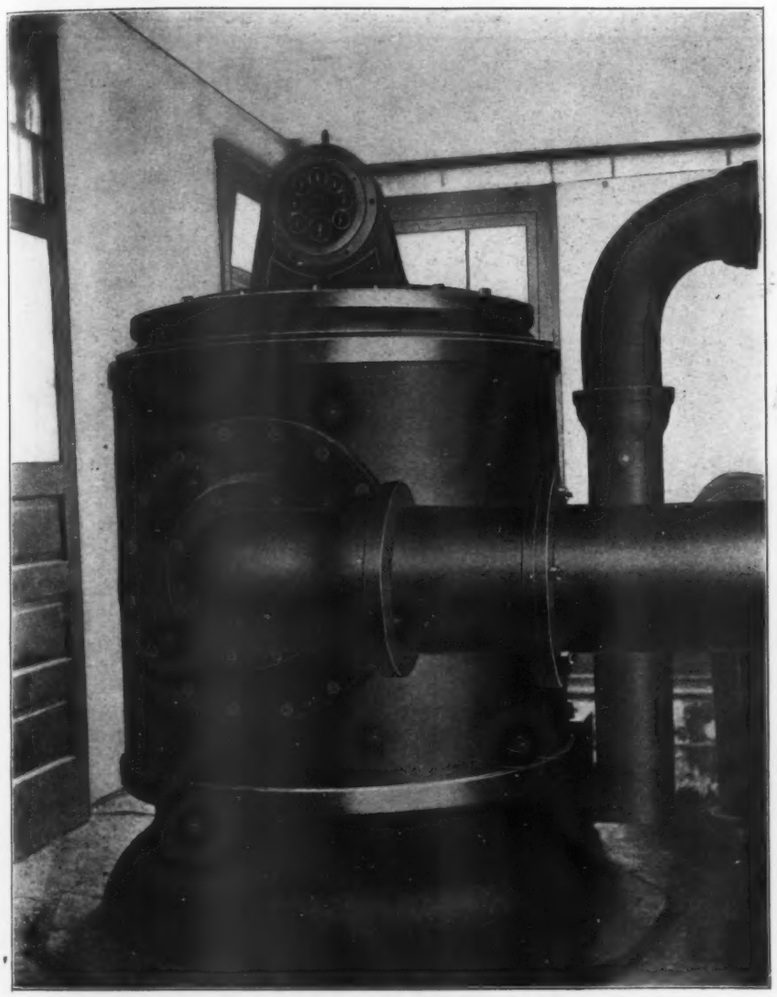

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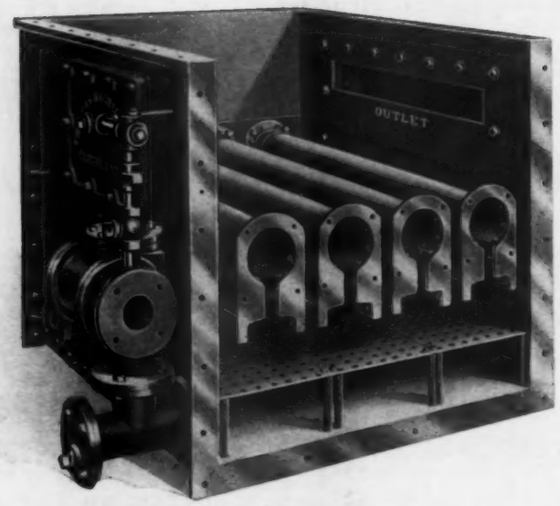

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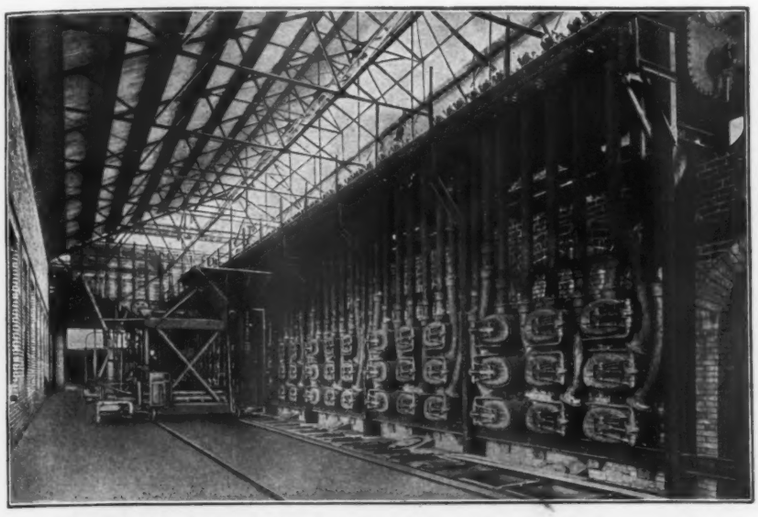

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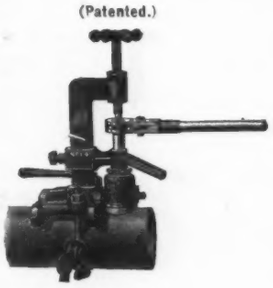

No. 14.

The prudent housewife "counts noses" and goes early to market, but the imprudent one delays until dinner time and then has trouble supplying her needs.

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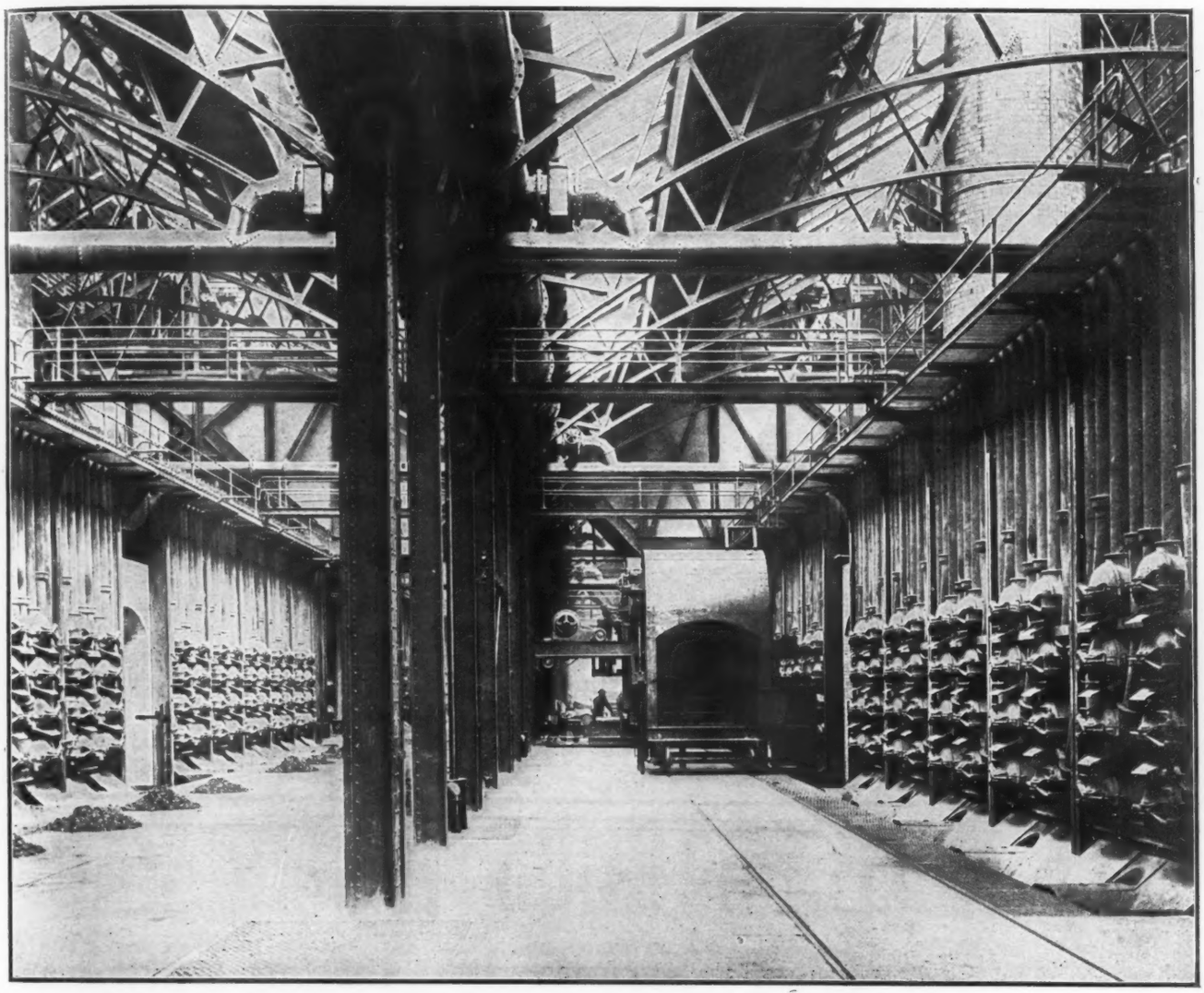

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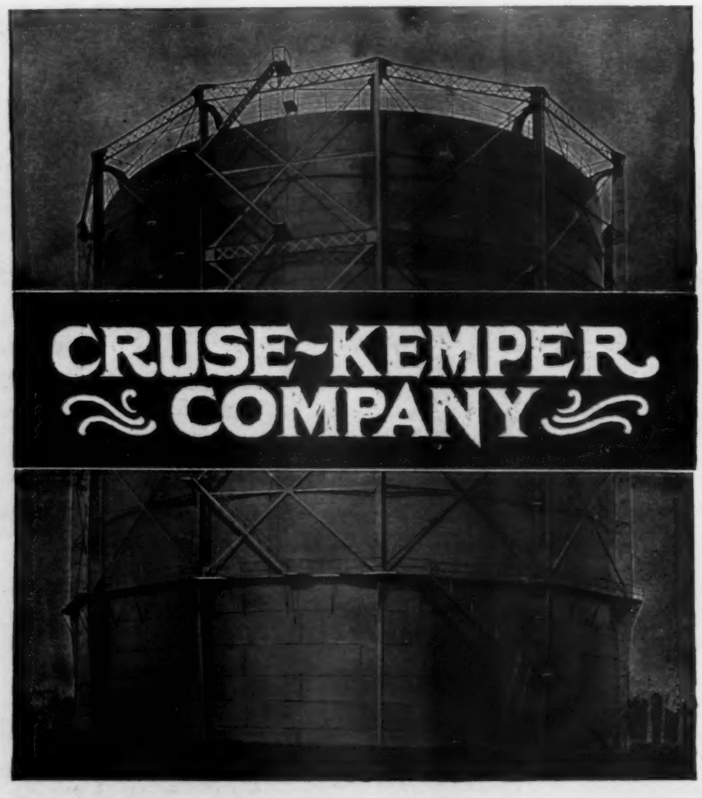

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We have a full line of sizes for all standard pressures. The design, material and workmanship is A-1. Prompt Delivery and Reasonable Prices. WHY NOT give us YOUR requirements?

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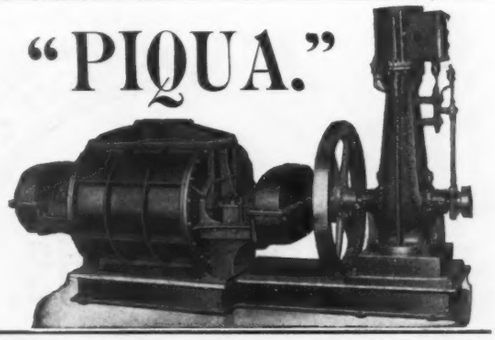

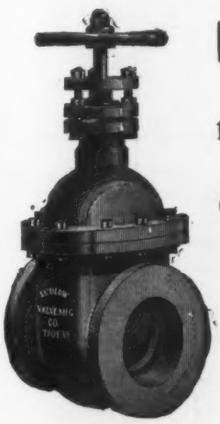

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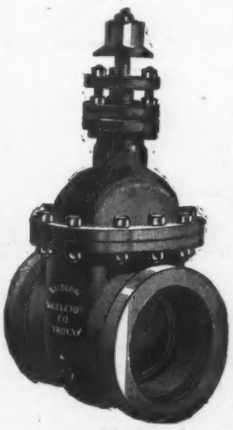

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"BETTER BENCHES"

All Workmanship, Material and Results Guaranteed.

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PRACTICAL HANDBOOK ON GAS ENGINES. WITH INSTRUCTIONS FOR CARE AND WORKING OF THE SAME,

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OVER FORTY YEARS IN USE THE WORLD OVER.
THE BEST STREET LAMPS for ALL KINDS OF GAS OR BURNERS.
This is only one of a Large Variety of Styles.
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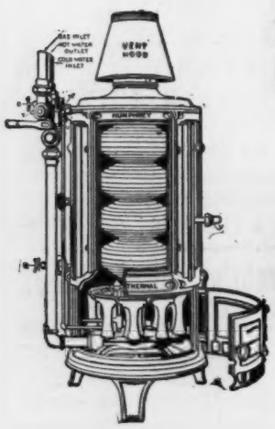

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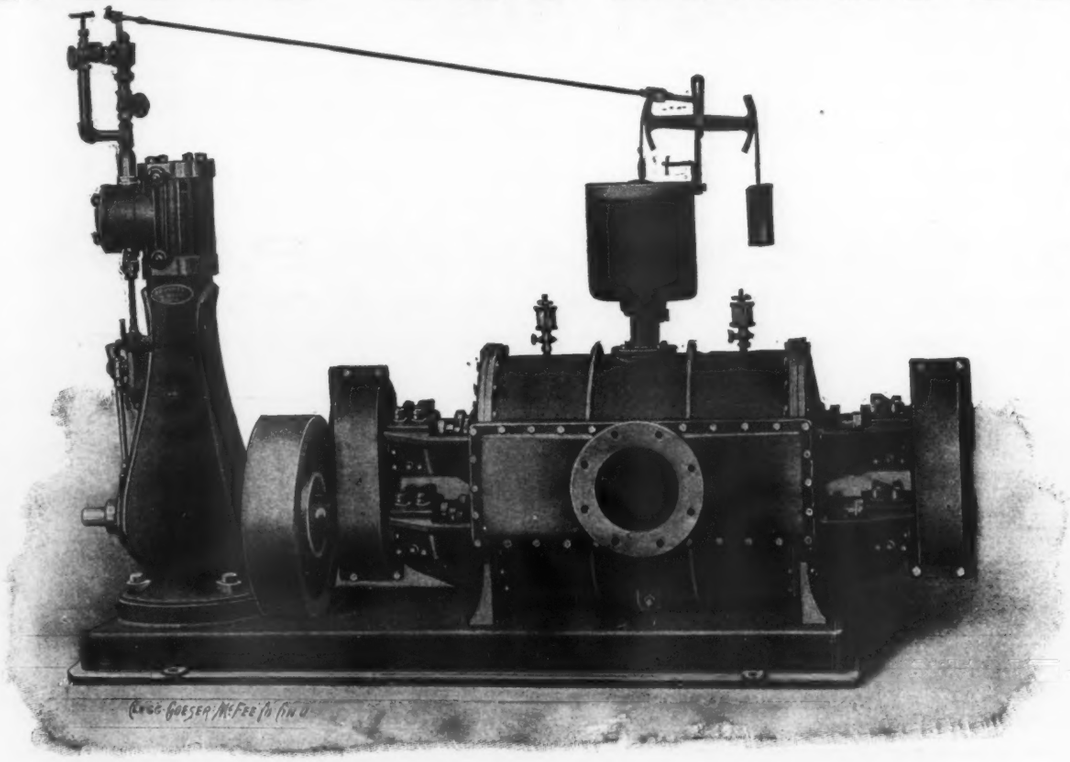

Sizes for any required capacity.

Self-oiling, adjustable bronze bearings.

Most perfect and sensitive Governor.

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This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

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In that time they have been recommended and used by the leading gas experts, endorsed by the U. S. Government Inspectors of Gas, as well prominent State Inspectors.

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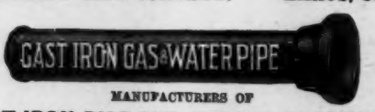

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"HUNT" LABOR-SAVING MACHINERY FOR GAS WORKS.

McDonald-Mann Quenching Chutes.
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Special Features are:

The Coke is quenched and dried when drawing from the Retort and Quenching Chute is completed.

Approximately only a pound of water is used to quench a pound of coke.

The Quenched Coke has a silvery luster.

No loss from incipient combustion.

Charging room is free from steam and gases.

Gas Engineers are particularly invited and requested to visit any of the Gas works equipped with our machinery easy of access from their vicinity. :: :: :: :: :: ::

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Should have a Copy of our 50th Anniversary Number (Price, 50c.), Containing the Following Articles:

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A Half-Century History of Water Gas. F. N. Morton.

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A Half-Century's History of Gaseous Fuel as Applied to Heating Gas Retorts. F. Bredel.

Systems of Vertical Retorts. Fred. J. Mayer.

Development of the Ammonia Industry in Gas Works during the Last 50 Years. R. W. Hilgenstock.

Residuals, Some History of. Carroll Miller.

Meters and Meter Makers. D. McDonald.

Progress in Electric Current Development in the Artificial Lighting Field. A. F. Ganz.

Development of the New Business Division of the Gas Industry during the Last 50 Years. Philmer Eves.

Growth and Value of Demonstration Work in the Household of Gaseous Fuel. Helen Armstrong.

"Uncle Jerry" in Reminiscent Mood. J. B Howard.

Present-Day Photometrical Practice. W. H. Gartley.

The Boston Gas Supply during 50 Years. William McKay.

Development in Pipe Manufacture. George W. Whyte.

Public Utility Commissions. Rufus C. Dawes.

Heating Machines. E. P. Reichhelm.

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NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

SEPTEMBER, 1909.

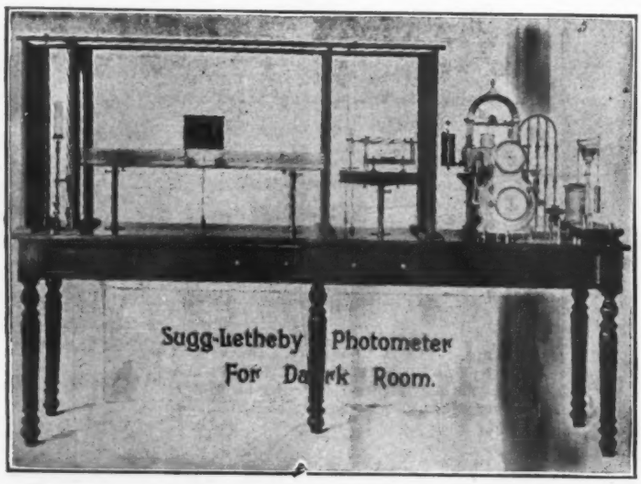
Table No. 1.
FOLLOWING THE MOON.

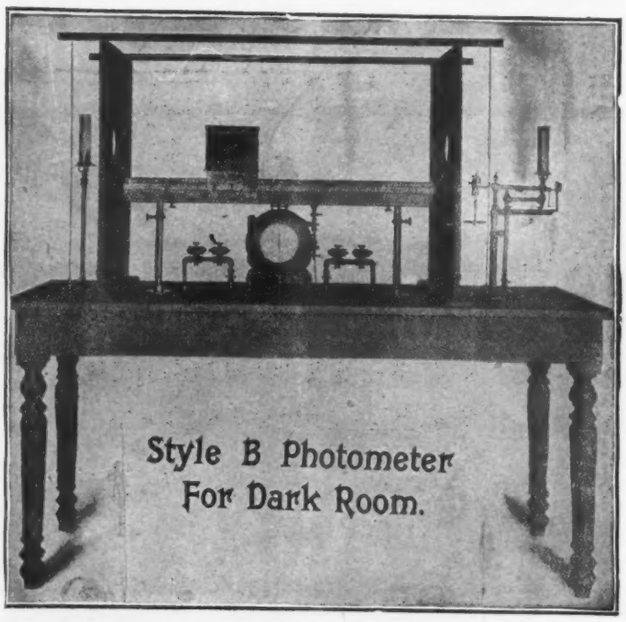
Day of Week.	Date.	Light.	Extinguish.
Wed.	1	7.00PM	8.50PM
Thu.	2	7.00	9.20
Fri.	3	7.00	9.50
Sat.	4	7.00	10.20
Sun.	5	6.50	11.00
Mon.	6	6.50LQ	11.40
Tue.	7	6.50	12.30AM
Wed.	8	6.50	1.20
Thu.	9	6.50	2.20
Fri.	10	6.50	3.20
Sat.	11	6.50	4.40
Sun.	12	6.40	4.40
Mon.	13	6.40	4.40
Tue.	14	6.40NM	4.40
Wed.	15	6.40	4.40
Thu.	16	6.40	4.40
Fri.	17	6.40	4.40
Sat.	18	6.40	4.40
Sun.	19	7.40	4.50
Mon.	20	8.10	4.50
Tue.	21	8.50	4.50
Wed.	22	9.40FQ	4.50
Thu.	23	10.30	4.50
Fri.	24	11.40	4.50
Sat.	25	12.50AM	4.50
Sun.	26	2.10	4.50
Mon.	27	3.20	4.50
Tue.	28	No L.	No L.
Wed.	29	No L FM	No L.
Thu.	30	No L.	No L.

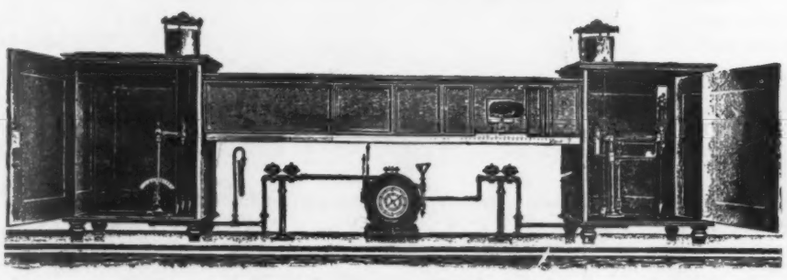
TOTAL HOURS DURING 1909.

By Table No. 1.

	Hrs.Min.
January	212.20
February	183.40
March	173.00
April	151.10
May	144.10
June	138.50
July	145.40
August	160.30
September	180.00
October	201.00
November	216.30
December	233.40
Total, yr.	2140.30







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

SEPTEMBER, 1909.

Table No. 2.
NEW YORK CITY.
ALL NIGHT LIGHTING.

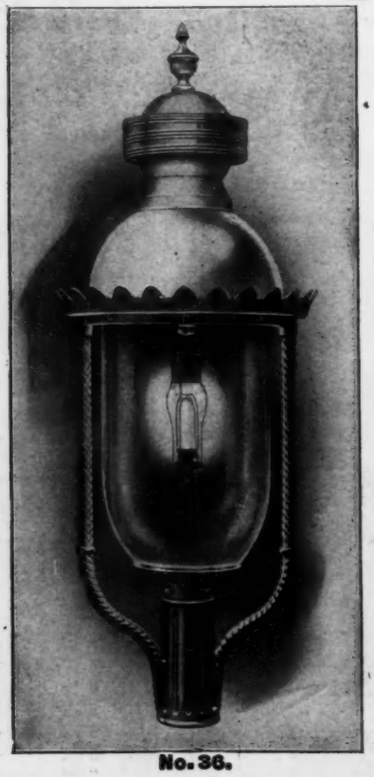
Day of Week.	Date.	Complete Lighting in One Hour	Complete Extinguishing in 50 Minutes
		From Time Given	
		P. M.	A. M.
Wed.	1	6.27	3.57
Thu.	2	6.27	3.57
Fri.	3	6.17	4.07
Sat.	4	6.17	4.07
Sun.	5	6.17	4.07
Mon.	6	6.17	4.07
Tue.	7	6.12	4.07
Wed.	8	6.12	4.07
Thu.	9	6.12	4.07
Fri.	10	6.02	4.17
Sat.	11	6.02	4.17
Sun.	12	6.02	4.17
Mon.	13	6.02	4.17
Tue.	14	6.02	4.17
Wed.	15	6.02	4.17
Thu.	16	6.02	4.17
Fri.	17	5.52	4.27
Sat.	18	5.52	4.27
Sun.	19	5.52	4.27
Mon.	20	5.52	4.27
Tue.	21	5.47	4.27
Wed.	22	5.47	4.27
Thu.	23	5.47	4.27
Fri.	24	5.37	4.37
Sat.	25	5.37	4.37
Sun.	26	5.37	4.37
Mon.	27	5.37	4.37
Tue.	28	5.32	4.37
Wed.	29	5.32	4.37
Thu.	30	5.32	4.37

TOTAL HOURS DURING 1909.

	Hrs.Min.
January	428.30
February	358.15
March	353.10
April	298.10
May	263.20
June	234.45
July	248.30
August	278.00
September	311.25
October	370.05
November	397.40
December	438.35
	3980.25
Deduct on account of 50 min. extinguishing time	30.25
Total, yr.	3950.00

NEW YORK, 318 West 42d Street. BOSTON, 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 512 Oak Street.

WELSBACH STREET LIGHTING COMPANY



No. 36.

....OF AMERICA....

Controls and Operates the **Welsbach System of Street Lighting,**

Which includes its specially DESIGNED and PATENTED BURNER for PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

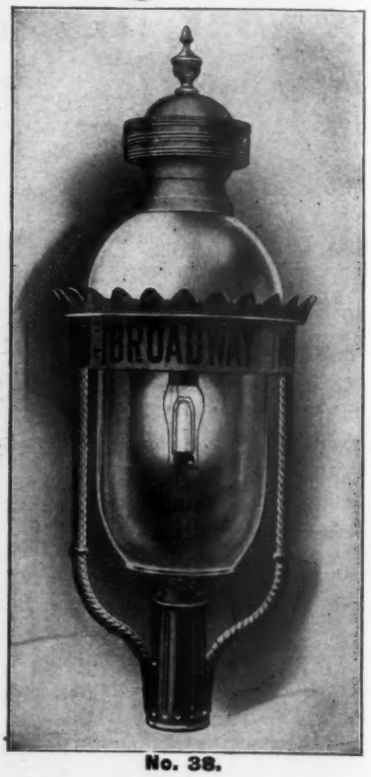
POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.



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THE BIGGEST LITTLE LIGHT IN THE WORLD.

The Welsbach Junior Light is 5 inches high--consists of burner, mantle and chimney--and is attractively boxed in a pasteboard carton.

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Showing Welsbach Junior Light used in connection with ordinary glass globe.

Gives 50-Candle Power.

Uses Two Feet of Gas per Hour.

Attaches to Any Gas Fixture.

Completely Hidden from View.

Use your own globe--either gas or electric.

SMALL—EFFICIENT—ECONOMICAL.

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Salesrooms in all Leading Cities of the United States.

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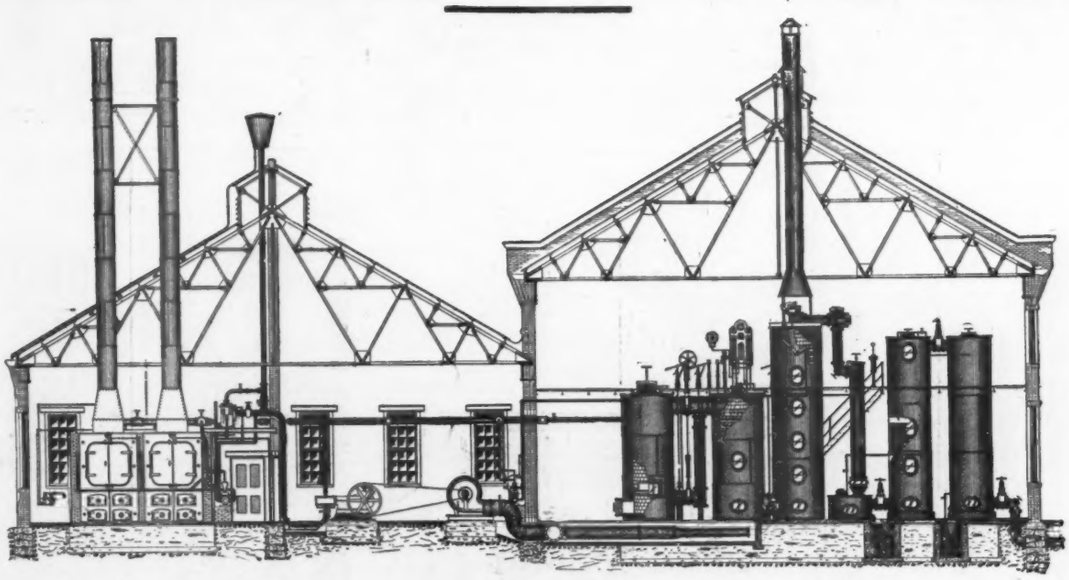
SOLE AMERICAN BUILDERS

OF THE

Standard Double-Superheater Lowe Water Gas Apparatus.



TOTAL SETS INSTALLED TO JULY 1, 1909, ... 704
TOTAL DAILY CAPACITY TO JULY 1, 1909, ... 577,440,000 cu. ft.

Tar Extractors for Carburetted Water Gas.
Photometrical Apparatus.
Gas Analysis Apparatus.
Recording Gauges.
Straight Standpipe System for Coal Gas Retorts.
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CLAY GAS RETORTS, FIRE CLAY TILES, FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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GEROULD'S IMPROVED RETORT CEMENT.

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
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KRATER-DINAS RETORT CEMENT.

Universally accepted to be the best cement for patching and repairing retorts, making up bench work, etc. Advantages: Powdered form; only mix with water; no waste; too much mixed, apply water and use the next time; adheres very easy; does not fall out by decarbonization. We guarantee or take back. Many re-orders and recommendations from America, Germany, France, Belgium, etc. Write for price and testimonials.

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ESTABLISHED 1868.

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HIGH GRADE FIRECLAY MATERIAL FOR ALL PURPOSES.

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BENCH CONSTRUCTIONS of the MOST DURABLE and EFFICIENT TYPE, WITH EITHER HORIZONTAL, INCLINED OR VERTICAL RETORTS.

SUPERIOR GRADE LININGS AND CHECKERBRICK FOR WATER GAS SETS.

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We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** The **Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* One *to* Six **Retorts.**

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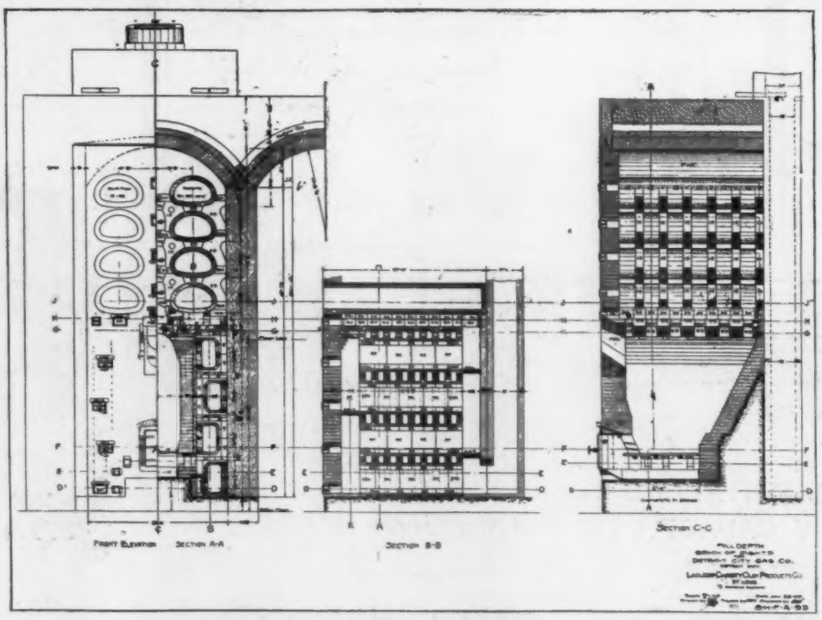
OUR REPUTATION IS OUR GUARANTEE.

Note heavy construction of Benches.



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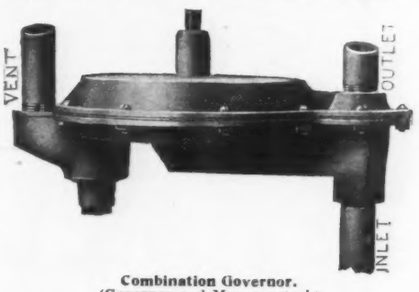

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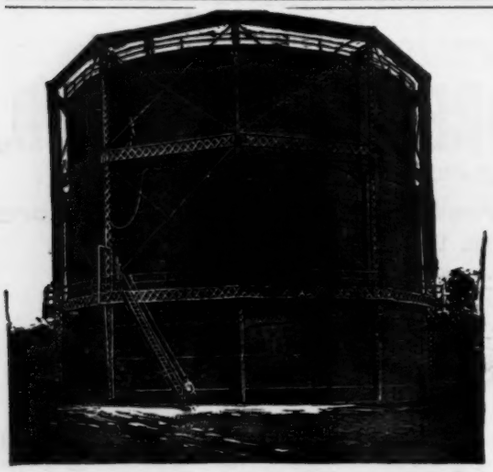

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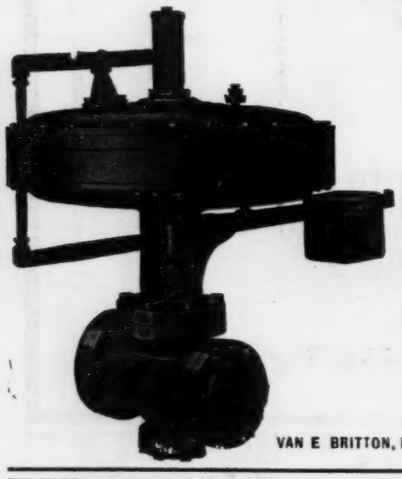

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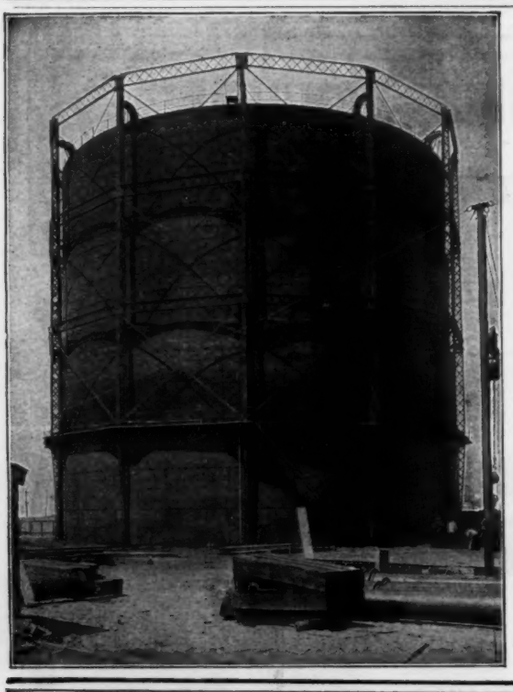

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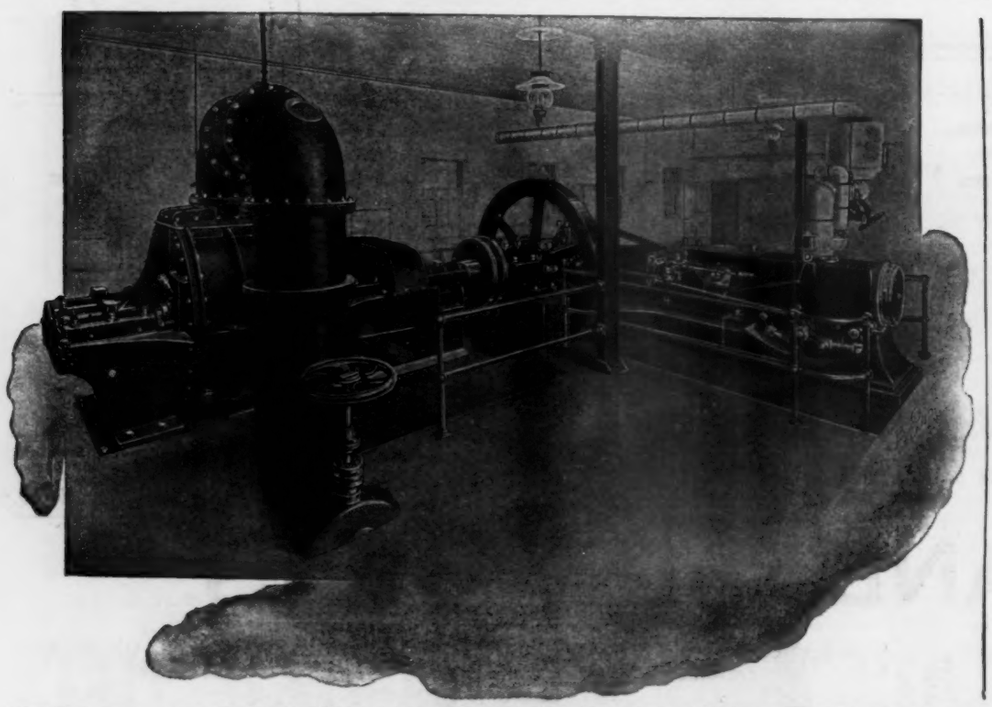

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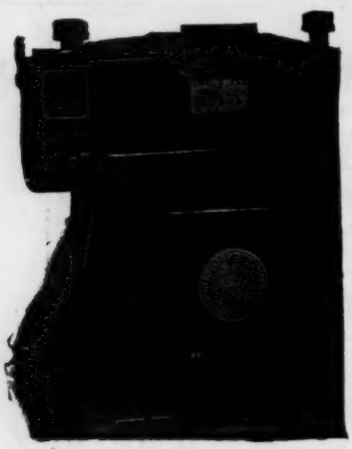

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